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The Magazine of New Energy Technology

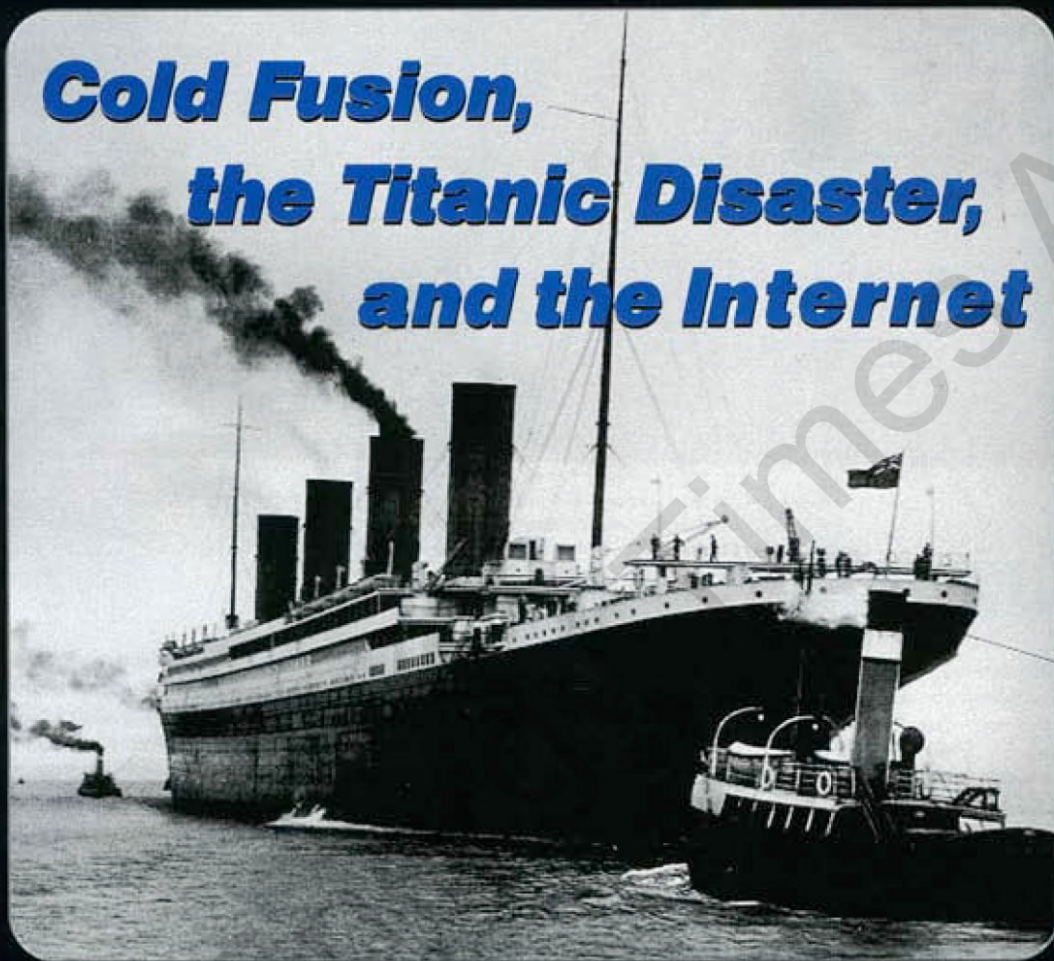
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Volume 6 • Issue 36 • 2001

Cold Fusion, the Titanic Disaster, and the Internet



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...if it turns out that cold fusion can be made into a practical source of cheap energy, then the consequences of the twelve-



year delay in launching serious, large scale research will turn out to be worse than the Titanic disaster. During

the twelve-year hiatus, more people may have perished for lack of energy and clean water than ever drowned in shipwrecks. . .

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Titanic cover photo: Titanic is towed out from Belfast after fitting out for her maiden voyage. Courtesy Titanic Incorporated Limited, from the archives of Harland & Wolff. Light bulb photo and cover art: Barbara DelloRusso.

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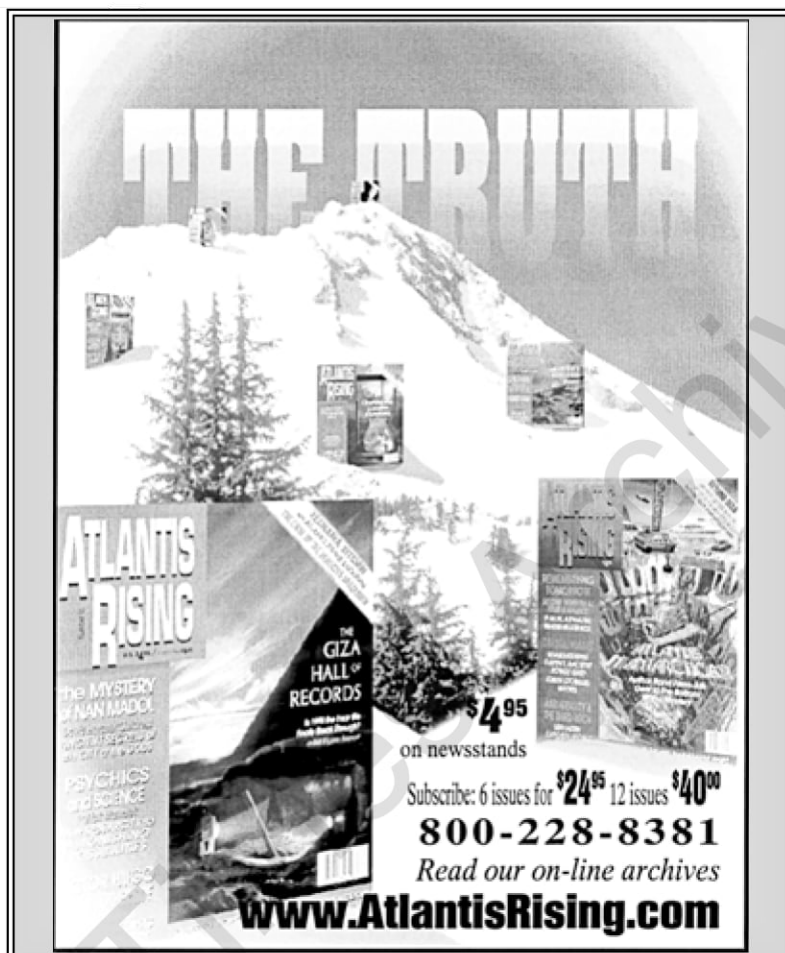
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The Oceans of “Free Energy”

by Eugene F. Mallove, Sc.D.



We don't shirk from stirring up controversy. In that spirit, this reflection might offend some—especially those who consider that only one generic source of “free energy” may exist. Perhaps they believe it is their favorite certainty, such as low-energy nuclear reactions (LENR/cold fusion) or hydrino energy (“shrunk hydrogen,” a la the science and technology that BlackLight Power Corp. says it is pioneering). Fair enough. There is little doubt that either or both of these generic sources, which seem to stem from anomalous behavior of hydrogen with catalytic agents, could power an advanced Solar System-wide civilization for millions of years. These sources do have behind them the largest body of published, replicated scientific supporting evidence, but they may not be the only sources.

Let us expand our horizons a bit more. First, some definitions. The heretical concept of “free energy” needs some clarification. It bears some relationship to “free information,” which only a few decades ago might have been considered “impossible” or unlikely to emerge in the near term. Yet we find ourselves in what could rightly be called the “Free Information Age.”

Once upon a time, scribes created scrolls and later illuminated books. Information was precious, expensive, and the privilege of an elite. The fifteenth century saw the advent of the printing press and information became more widely disseminated, but it was still relatively expensive to obtain—except much later on trips to the public library. If you bought the *Encyclopedia Britannica* as recently as in the mid-1980s, you'd have to pay about \$1,500. Now you can get it virtually free from the Internet or on a CD.

Free energy will be that way. As many Web surfers know, information has become virtually free. If one had to pay the former cost of all the physical documents, images, videos, audio records, and much else that can be accessed today on the Internet for a nominal monthly fee, it would cost many millions of dollars. Some of this information would not have been obtainable at any price, and today's access speed would have been impossible. “Free energy” will be energy on demand with effectively zero recurring cost, *i.e.* no “fuel” cost, once the capital equipment has been purchased.

The free energy of advanced hydrogen catalysis—cold fusion/LENR/hydrinos—will be extracted from oceans of water. But there are at least two other “oceans” from which other forms of free energy might conceivably come. Ocean No. 1: “Empty” space itself and Ocean No. 2: The thermal energy of the environment, which is the kinetic energy of speeding and vibrating atoms and molecules. (For the purpose of this discussion, let's exclude such understood “free energy” sources as wind energy, solar energy, geothermal energy, and the like, which are not so “free,” as it turns out.)

Access to Ocean No. 1 by any mechanism, electromagnetic or otherwise, would require, according to today's establishment physics, creating a “Perpetual Motion Machine of the First Kind” (a PMM-1). Inventors of various claimed “over-

unity” electromagnetic machines and theorists who support the possibility of such devices would disagree. Whether Ocean No. 1 be called “space energy,” “zero point energy” (ZPE), or “aetheric energy,” the energy would have to come from somewhere, a radically new plenum—or an old plenum, the “aether,” which Einstein and his followers supposedly abolished with Special Relativity. The conservation of energy, though apparently violated by a PMM-1, would be rescued by postulating this new ocean of free energy. Mainstream cosmologists who blithely discuss cosmic “dark matter” and “quintessence” energy should actually be very comfortable, in a theoretical sense, with the possibility of a PMM-1.

Access to Ocean No. 2, environmental thermal energy, would require a Perpetual Motion Machine of the Second Kind (a PMM-2)—one that could extract useful work from an environment of essentially uniform temperature. (We exclude the known technologies of tapping small or large thermal differences in environmental reservoirs.) Far fewer investigators, less than a dozen known to us, have had the audacity to consider trying to create a PMM-2. The Second Law of Thermodynamics in several of its explicitly stated forms would be violated by a PMM-2. The Second Law is, indeed, a harsh taskmaster. Einstein himself once asserted:

A theory is the more impressive the greater the simplicity of its premises, the more different kinds of things it relates, and the more extended its area of applicability. Therefore the deep impression which classical thermodynamics made upon me. It is the only physical theory of universal content concerning which I am convinced that, within the framework of the applicability of its basic concepts, it will never be overthrown.¹

Yet, some experimenters and theoreticians, have had apparent success in finding chinks in the Second Law's armor. We have not yet published the experimental results of several of those who have come to our attention, though we have mentioned the work being done at Entropy Systems in Ohio (see *IE*, No. 29, p. 49). Entropy Systems does not have anything like a self-running PMM-2. Others appear to have created extremely low-power demonstrations that are still astounding, in view of the sacrosanct principle they appear to violate. In one case, the evidence emerged from a highly credible source, not long before the cold fusion furor of March 1989; it thus seems to have disappeared from the radar screen. In future issues of *Infinite Energy*, perhaps as soon as our next issue (if arrangements can be made), we hope to present some of this evidence. Is that a prelude to more robust power systems? It is simply too early to tell.

The most important message in this enumeration of oceans is to remain open-minded about what the future may hold for the free energy scene. Recall that prior to 1989, almost no one could have imagined that something as radical as solid-state cold fusion would be discovered. Now that the data supporting cold fusion has been handed to establishment physicists on a silver platter, they continue to ignore this remarkable condensed matter phenomenon. Thus, we were amused by physicist N. David Mermin's list of ten questions he would

wish to ask a colleague from the year 2100, if he (Mermin) awoke from a one hundred year sleep. His Question No. 6 was (*Physics Today*, February 2001, p. 12): "Tell me about a collective state of matter, unimagined in the year 2000, that is as remarkable as, for example, superconductivity, superfluidity, or the fractionally quantized Hall effect seemed to be at the end of the twentieth century."

Mermin also wrote of this question No. 6, "I'll take my chances that the question will not elicit giggles." Unknown to Mermin, it already has! To my astonishment, his very next comment was: "One could ask a similar question for similar reasons about controlled nuclear fusion, even though that quest has only been with us for fifty years." Physicists in 2100 reading this will know for sure that late twentieth century physicists were, by and large, plodding dullards.

I'd like to ask the physicists of 2010, much closer to us temporally, which of the three free energy oceans have been tapped and reduced to practical devices? Let me be bold and make a prediction: all three. Of course, I'll settle for just one and be very happy when that comes about. Perhaps some creative reader will inform me of another generic "free energy" ocean that I may have omitted. I'd love to hear about it.

Reference

1. Lieb, E.H., and Yngvason, J. 2000. "A Fresh Look at Entropy and the Second Law of Thermodynamics," *Physics Today*, April, p. 32.

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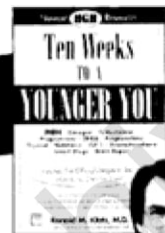
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Charles G. Beaudette

Foreword by
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Introduction by David J. Nagel, Ph.D.
Research Professor
The George Washington University

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LETTERS TO THE EDITOR

Praise for *Infinite Energy*

Thankfully, I found a copy of *Infinite Energy* at Bookstop (a Barnes and Noble store) today. I will be sending in my subscription tomorrow. I am very gratified to have been able to obtain a copy and I look forward to receiving the magazine from you by mail in the near future. I hope you will be able to continue this fine magazine. The topics are fascinating and you perform a very important function in keeping public interest in ZPE, cold fusion, etc. aroused.

I am anxious to see some of these technologies become practical in our culture in the very near future. I guess only time will tell, though. In the meantime, you really are whetting my appetite. I happen to know Hal Puthoff and am very excited about the work he and others are doing on the theoretical side. I am hopeful that we will have a functioning starship before I pass on. I would really love to see that. And I really believe in and support the work you all are doing.

Jim King, Executive Director
Institute for Neuroscience and Consciousness Studies
Austin, Texas



Some Failings of Conventional Renewables

After hearing Dr. Mallove several times on the radio, I thought that he might be able to answer a question for me. The question is: How can we continually generate two to ten amps at 12V DC cheaply?

We are now living off the grid relying on solar panels and wind generators, both of which have fallen short this year. We felt this more this summer when we had many still, overcast days. We rely on these units to supply our storage batteries for winter usage. We are going into the "short" days with only half of our capacity. If we could use our woodstoves, or the river that flows by our homes, to generate a small amount of power consistently and cheaply, it would fill our batteries over a longer time but be more reliable. Is a small cold fusion unit in our future? Or can you steer us in a direction where we could find a small 12V DC two to ten amp generator that puts out at a low RPM? We have seen units with power plants attached, but this is unacceptable because of their use of fossil fuels. Also, most of these units are geared to AC output which, as you know, can't be stored. We have tried many manufacturers but without much luck; however, I must admit that our resources are limited.

Thanks for any help which you might give.

Paul Gross
Pittsfield, Maine

Editor's Reply: I am happy that you heard me on the radio several times—glad we are reaching the great state of Maine! Your query points out the well-known difficulties of conventional renewable energy, such as solar and wind power. To answer you directly, unfortunately there are no commercial devices from the cold fusion/new energy field right now that can "top off" your batteries as you require. However, with adequate perseverance it is inevitable that our beleaguered field will come to your rescue in due course, perhaps within the next few years.—EFM

Joining Disciplines of Science

The fields of ball lightning and cold fusion have separate conferences. Could I suggest that cold fusion researchers, ball lightning researchers, and the members of the committees in both fields consider a joint meeting, or holding two meetings simultaneously? This would mean rescheduling one or both conferences a little.

Since 1989 there have been eight international conferences on cold fusion. The next is tentatively scheduled for China in 2002 (<http://www.frascati.enea.it/iccf8>). There have been a similar number of international conferences on ball lightning since the mid-1980s. The next is scheduled for St. Louis in the U.S. in 2001 (<http://home.wxs.nl/~icblsec/>).

More prominent cold fusion researchers accept the role of microscopic ball lightning in the transmutation process than they did five years ago, and at least two papers at the ICBL99 discussed transmutation in ball lightning. The Russian Conference on Cold Nuclear Transmutation held in 2000 had ball lightning as one of its main topics of discussion.

I published an article titled "Tornadoes and Ball Lightning" in *IE* No. 30, which is mainly about cold fusion research, and letters to the editor in the September 1999 and May 2000 issues of *Fusion Technology*, which is a journal devoted to fusion engineering. In the letters to the editor of *Fusion Technology*, I discussed some evidence and ideas about the role of ball lightning in cold fusion.

Edward Lewis
Champaign, Illinois



Revisiting Old Research

In 1989 I tried to replicate the Fleischmann and Pons-type experiment, thereby using a palladium cathode (10x10x2 mm) and a platinum anode. During an extensive period of electrolysis of heavy water + LIOD (three weeks continuously at 3 volts, .5 amps) I did neutron count measuring. There were no neutrons above the background.

Then I shortcut the platinum anode and palladium cathode to create sparks under heavy water (peaks of 10 amps were reached). This also had no effect on the neutron counts.

The following step was the introduction of a strong magnetic field created by a solenoid (+/- 1 Tesla) under heavy water sparking.

What struck me was the formation of tiny spherical light emitting structures which circulated above the heavy water surface (like ball lightning). Also in a few occasions the scaler of the neutron counter was giving a high count rate. During this event, the heavy water solution boiled dry very fast.

Because the effect was not completely reproducible and due to the fact that the neutron counter which I was using was sensible for noise signals, electromagnetic noise, moisture, etc., I doubted my neutron measurements. As my premier focus was on radiation measurements, I did not concentrate on the boiling dry effect and the formation of the "ball lightnings."

Now ten years after these results, I think that the formation of these tiny light emitting objects have something to

do with resonance phenomenon and could be related to heat forming reactions.

As for now I will try to replicate these old results.

Peter van Noorden
Netherlands



Humor, Blimps, and Fissioning Electrons

Your Issue No. 34 stimulates three responses:

1) Hurrah for Soo Seddon. It's the silliest name since Siegfried Sassoon, but a breath of fresh air. I am installing her in my Pantheon, alongside Gary Larson, Scott Adams, and Dave Barry, wherein I honor the gift to transform our pompous march to the grave into a jig.

2) To Jed Rothwell's list of failed technologies that probably never deserved to fail, such as rotary engines, hovercraft, and weather modification, I'd like to add blimps and dirigibles. I still remember as if photographically, when first approaching Manhattan from the west at the age of four, my sunset view of the skyscrapers, and low over them, big as any skyscraper and gilded like a benediction made tangible, the Graf Zeppelin. More than seventy years of anticlimax have never brought me such a sight again. And if you examine the Navy's reasons, some years after World War II, for dropping blimps from the U.S. arsenal (one of the more potent anti-submarine warfare weapons, and one unique to us because of our near-monopoly of helium), I don't think you will find technical failings at the top of the list.

3) Concerning the alleged fissioning of electrons, reported by H. Maris on the basis of fissioning bubbles contained in liquid helium, I have not seen the original report nor been able to discern from what has appeared in the popular accounts that this differs much from the "fissioning" of a photon or electron that goes into two beams in a double-slit experiment. As I understand the observation, a single electron is contained in a bubble, and that bubble is induced to split into two or more separate bubbles, each containing a portion of the electron's wave function. Consider two such, and suppose one of these half-bubbles is interrogated by a "detector" that measures an electric charge equal to half that of an electron. Then that is new and does indeed overthrow quantum mechanics. Also, if the half-bubble is interrogated, destroyed, and yields a whole electron charge *without the simultaneous disappearance of the other half-bubble*, that, too, is revolutionary (though surely hard to verify and also hard to credit, because it suggests that the other half-bubble likewise contains a whole electron charge, thus violating not only quantum mechanics but charge conservation as well).

But if, instead, what is observed is the detection of a whole electronic charge with simultaneous disappearance of both half-bubbles, this not only agrees with quantum mechanics and charge conservation but is exactly what one would expect from the double-slit analogy, wherein there is part of the wave function in each of two beams. In all past experiments the individual event of "detection" never produced anything but a single "quantum," whether photon or electron. That's what quantum theory is about. The crucial question: Has Maris detected a partial electronic charge (the "sub-electron," as Ehrenhaft called it)? Or has he merely observed a pure-state electron split up into spatially separated parcels *prior to detection*? It's the localized detection event (charge measurement), not the non-localized pure-state inference, that defines the revolution. A wave function in two bubbles or two beams is

not localized and is not a "completed quantum process." To conform to quantum theory, the parts of the electron must "jump" into one whole when detected (process completion), and they can jump clear across the universe. If that's been violated, there is indeed cause for rethinking. Phil Anderson says Maris must be wrong, "But it is not obvious why." If it's not obvious then I am wrong, because all said here is obvious.

Thomas E. Phipps, Jr.
Urbana, Illinois



Correction—Dash Cells

Thanks for Jed Rothwell's report on our work (in *IE*, No. 35, p. 18). I would like to make two corrections:

1. The uranium is co-deposited with hydrogen by electrolysis, using nickel cathodes, a platinum anode, and an acidic electrolyte. Your report implies that uranium is deposited on nickel prior to electrolysis.

2. Our data shows that radiation is emitted at a greater rate from the electroplated uranium than from the starting material (U_3O_8). However, we do not have an accurate analysis of the uranium content of the electroplated uranium. It is possible that it contains more uranium than the starting material, and this could account for the increased rate of radiation emission.

John Dash
Portland State University
Portland, Oregon



Correction and Comment

As Editor-in-Chief of *Infinite Energy* I wish to apologize to CETI and to Dr. James Patterson for unknowingly misrepresenting CETI's stance toward other people replicating its published experiments in their laboratories. In his article on cold fusion in Japan (*IE*, No. 35, p. 15), Jed Rothwell wrote: "At the ANS conference, George Miley said that the University of Illinois will not replicate the CETI design because of the possibility of CETI threats. They discourage replications, even threatening to sue people who try the experiment!" Jed Rothwell's last sentence is not correct. Dr. Patterson told me, "CETI grants anyone the right to attempt to independently replicate our metallic-coated bead experiments for scientific validation and will not bring suit against them for doing so." (Selling such cells, on the other hand, would be a violation of CETI's intellectual property rights, but testing models of them would not be.)

On page 20 of the same issue, Jed Rothwell remarks about Prof. George Miley: "I asked [Miley] why he does not use beads. He said it was because CETI has threatened lawsuits for patent violation." We are sorry that this, again, gave a false impression. In fact, Prof. Miley has worked in cooperation with CETI on thin-film cell work. He evidently intended to state that he did not wish to provide coated beads to New Energy Research Laboratory for its demonstration excess heat cell kit. To have done that would have violated CETI's intellectual property. We hope that this clarifies the feelings and intent of all parties.

—Eugene F. Mallove



Deuterium Versus Hydrogen Systems

Over the years, cold fusion researchers have noticed a peculiar thing when electrolyzing with palladium versus nickel cathodes. Generally, palladium gives excess heat with heavy water, but not with light water. Conversely, nickel gives positive results with light water, but not with heavy water (except possibly at high temperature). The MODS theory of cold fusion (*IE*, No. 28) might explain this behavior.

During electrolysis of heavy or light water, deuterons (D) or protons (H) can load into the metal lattice as individual particles or as chain-like entities. It is proposed that H- or D-chains diffuse through the lattice more rapidly than do individual ions. Supposedly, D-D or H-H bonds in the chains weaken the metal hydride bond. (We need not be concerned about comparing the strength of, for example, a single D-D bond in a D-chain with the strength of a single Pd-D bond. D-chains and H-chains are thought to behave as macro quantum elements, which involve multiple quantum interactions acting together non-locally to bring about increased effects.) The dominance of metal-hydride bonds would slow the diffusion rate of D or H in the lattice. In other words, H- or D-chains have more mobility in the lattice than do "individual" H or D particles—a necessary condition for cells to become active (see *IE*, No. 35, p. 9).

From the accumulated cold fusion evidence, it is also predicted, by the MODS theory, that D-chains can form quicker than H-chains in the lattice surface. Protons must be closer together to form H-chains. D-chains form better in palladium than do H-chains. When equal loading rates occur at the surface (*i.e.*, equal "spacing" exists between deuterons or protons), D-chains that form will be stronger and will behave as large extended coherent elements, nearly unbound to the lattice atoms. Therefore, D-chains migrate and oscillate in the lattice more freely than protons. The H-Pd bonds hinder the mobility of protons entering (or leaving) the lattice.

The result of the above analysis is the observation that palladium-deuterium systems can give excess heat, but palladium-hydrogen systems do not, unless the local loading of H in the active sites is higher. High local loading of H in palladium occurred in Dr. Eiichi Yamaguchi's famous outgassing experiments in 1989 and 1990, in which "accumulation layers" of protons formed in the surface regions of a palladium foil that had been earlier loaded with hydrogen gas, and then was allowed to outgas through a manganese oxide layer. Massive excess heat was momentarily produced (see *21st Century Science & Technology*, Vol. 5, No. 3, Fall 1992, p. 71).

Predictions from the MODS model that may account for excess heat from nickel-hydrogen cells, and the apparent lack of heat from nickel-deuterium cells (except at high temperature) are a little more difficult to make. As a first consideration, I understand that nickel cathodes do not absorb D or H as lavishly as does palladium. The active regions are in the surface layers of the lattice anyway. The success of Ni-light water electrolysis implies that the nickel lattice can assemble H-chains at and near the surface—that protons being loaded will form the close-unit chains needed for reactions.

The general failure of Ni-D experiments means that D-chains do not produce the kind of collective and coherent oscillations required for D+D fusions, in the MODS theory. Yet, the expectation from the current analysis is that

deuterons, loading into the nickel surface, would more easily make D-chains than protons would make H-chains.

Perhaps the quick success of assembling deuterons at the nickel surface is the very source of the failure to execute excess heat during electrolysis. Deuterons, loading into nickel, form "virtual D-chain states" before identifiable real chains have formed. However, surface deuteron crowding assures interfering and competing quantum interactions between the virtual D-chains, so that the virtual D-chains (or D-strings) segment and clump together (form knots), resulting in aggregates of deuterons that are too small to create collective oscillating energies sufficient to bring about D+D fusion reactions. Only some low energy-yielding transmutations of nickel might occur.

At elevated temperatures in a Ni-heavy water cell, the knots in the deuteron clumps will unravel (untie), allowing the virtual deuteron chains to become real D-chains of sufficient length that the energy of their collective and coherent oscillations can gather into wave pulses large enough to bring about D+D fusions—and the excess heat. If such an active cell were cooled, I would not expect the real D-chains to fall through the virtual D-chain states and revert back to the mundane deuteron-clump states. The Ni-D cell should remain active, as long as the nickel does not deload.

It is interesting to note that titanium-heavy water electrolysis experiments apparently do not have the same "deuteron clumping" problem on the Ti surface as the nickel experiments do. Professor John Dash (Portland State University) frequently uses titanium-heavy water cells in his research.

These theoretical ideas to explain the success or failure of nickel or palladium in H or D are only one aspect of a complex environment existing at the surfaces of electrodes used in cold fusion electrolytic cells.

David Moon
Minneapolis, Minnesota



Cold Fusion on the Radio

In early January, Tom and Ray Magliozzi of the weekly "Car Talk" syndicated radio program mentioned cold fusion while talking with a hot fusion physicist about his car problem. They didn't bad mouth cold fusion, so either they were on your side or didn't know that much about it—unless of course you had previously sent them some literature.

Naturally you have heard about the problems out here in California with regard to electrical power supplies and distribution. What an endorsement for the future of cold fusion! I am sure you will have something upcoming about this in future issues of *Infinite Energy* [see page 49 of this issue]. However, I am also sure that California Governor Gray Davis would also be interested. Not to mention Pacific Gas & Electric in northern California and Commonwealth Edison down south.

Keep the faith, mon vieux.

Frederic Jueneman
Newark, California

Editor's Reply: Thank you, Fred. I heard the "Click & Clack" program myself in the midst of the election of 2000 recount battles. I encourage all *Infinite Energy* readers who call Tom and Ray's program, "Car Talk," (1-888-CAR-TALK) to make reference to the possibilities of cold fusion or other new energy-related means of powering automobiles.—EFM



Cold Fusion, the Titanic Disaster Aftermath, and the Internet

Jed Rothwell

"News is the first rough draft of history."

—Newspaper publisher Philip L. Graham (1915-1963)

Newspapers are indeed the first draft of history and, in many cases, the last draft as well. This has been one of the reasons behind cold fusion's bad press over the years. Researchers made initial assessments of the phenomenon back in April 1989 and offered up their gut-reaction opinions to the media. Many of these erroneous, off-the-cuff ramblings are still widely quoted today. The three famous "negative" experiments at Caltech, MIT, and Harwell are often cited as proof that cold fusion does not exist, although careful reexaminations have subsequently shown that the tests conducted at all three establishments did, in fact, yield positive results. Reporters, commentators, and historians seldom look beyond immediate impressions formed in the earliest days of a major event, when confusion is rampant and detailed investigations have not yet begun. This is the pattern with many controversial events, particularly crises that upset people, flummoxed the experts, and aroused passionate, snap judgments. Perhaps the most infamous example was the 1912 Titanic disaster. In many respects, it bears striking similarities to the events surrounding the introduction of cold fusion in 1989.

The Titanic disaster is one of the most closely documented incidents in history. It was the focus of a Congressional investigation in the United States, and a Board of Trade investigation in England. It dominated the news for weeks. It has been the subject of thousands of articles, books, and movies. Minute-by-minute chronologies have been compiled. Historical societies in England, the United States, France, and elsewhere are devoted to the Titanic. On the Internet many extensive web pages can be found, including an *Encyclopedia Titanica*¹ with thousands of photographs and biographies, and dozens of scholarly essays on subjects ranging from "Biodeterioration of the RMS Titanic" to the life story of the maid who accompanied Mrs. John Jacob Astor.

Despite this close attention, in many accounts crucial facts are confused, misrepresented, distorted, or covered up. In the weeks following the disaster, erroneous statements were published in the newspapers, and many are repeated today. Here is a good example, from a four-page article in a popular history book:

The Titanic was traveling at twenty-two miles per hour through ice-dotted waters in an attempt to break the record for a trans-Atlantic crossing.²

—M. Hirsh Goldberg

The Titanic could not have broken the record for a trans-Atlantic crossing. It was designed for comfort and fuel economy, not speed. It was equipped with two oscillating steam engines and one turbine, whereas by 1912 the record-holding ships used pure turbine propulsion, which is faster. Goldberg would have discovered this fact in most introductory articles about the Titanic. If he had dug a little more, he would have learned that the Titanic's sister-ship Olympic

The 1989 mass media brouhaha that erupted around cold fusion, although far smaller in scale [than the Titanic disaster], engendered similar confusion, which has also remained uncorrected in the popular imagination.

was launched a year earlier, but it did not break the speed record. Furthermore, steamships were seldom pushed to top speed on their maiden voyage, because that was not good for the engines.³ This rumor about a speed record appeared in many newspapers following the disaster. It has been copied ever since. Goldberg repeated other egregious mistakes:

"The ship's designers had reinforced the bow . . . But there was not much they could do with the sides of the ship below the waterline." The Titanic was double-hulled, an important innovation still missing from some modern ships, including the Exxon Valdez.

"Its designers thought of one other attribute that would set the Titanic apart from all other ships: It was built to be unsinkable." The implication here is that watertight subdivided compartments were innovative or unique to the Titanic. All British steamships built after 1894 had to have watertight compartments, by law, and the first large ship with a double-hull was the Great Eastern in 1858. Goldberg notes correctly that technical journals called it "practically unsinkable," but after the accident, the public forgot that caveat and accused the shipowners of saying it was absolutely unsinkable.

"[Regulations] called for ships . . . to have a minimum of 16 lifeboats, but in a classic Catch-22 of error, no one thought to increase the minimum number of lifeboats for the 46,000 ton Titanic." The designer, Alexander Carlisle, originally proposed forty-eight lifeboats, which was enough for all passengers and crew.⁴ After well-documented exchanges between the designer, owners, and builders, the number was whittled down to twenty, including four collapsibles. The deck and davits were built as originally planned, with the capacity for forty-eight boats. Immediately after the accident, the crew of the sister ship Olympic went on strike and refused to leave port until enough boats were installed, which was easily done.

The ship was traveling at 22.5 nautical miles per hour, or 26 miles per hour. Contrary to many accounts, this was not quite top speed, which was about 24 knots, but it was too fast for an area where icebergs had been reported. Other ships in the area had slowed or stopped for the night.

Where These Mistakes Originated

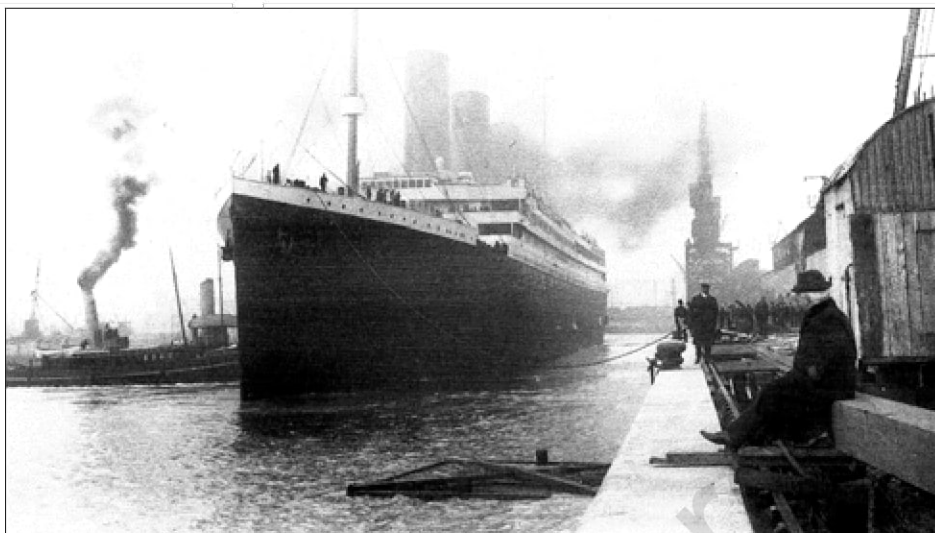
People who expect to drown in a dark night at sea do not make careful, objective observations or keep notebooks. The ship sank, most expert witnesses died, the evidence vanished. The details brought out during the investigation were astonishing and appalling, such as the fact that many

lifeboats were only partially loaded, and the fact that another ship, the *Californian*, stood ten miles from the disaster and did nothing. The captain and crew saw the distress rockets, yet they did not even wake up the radio operator. While responsible reporters did their best to print the facts, yellow journalists invented sensational stories and passed them off as news. The truth was as lurid as the invented stories, so it is no wonder people could not tell them apart. News of the sinking was a worldwide sensation. Rumors flew. Crowds of reporters and terrified relatives besieged distraught officials. This was not an environment in which you could expect carefully thought out, accurate fact-finding. The 1989 mass media brouhaha that erupted around cold fusion, although far smaller in scale, engendered similar confusion, which has also remained uncorrected in the popular imagination.

Confusion about the condition of the ship itself remained until the wreck was discovered. Most experts thought that a large gash had been torn in the side. Some eyewitnesses reported that the ship broke apart as it sank, but most shipbuilders dismissed that as impossible. The wreckage revealed that the ship did break apart, and there does not seem to be a gash after all, only small holes. In the absence of evidence, such mistakes are understandable. Similar confusion about the cold fusion effect lingered until 1991, when careful replications were published.

Mistaken impressions, hysteria, and distortion in the heat of passion back in 1912 are understandable. By 1984, when Goldberg wrote his book, the facts were reliably established. He should have spent a little more time at a public library. By the early 1990s, facts about the Titanic were available on the Internet, but not in much detail, because the cost of on-line storage was high. The Internet was "an ocean a thousand miles wide and one inch deep." Today, you can find hundreds of detailed articles about the Titanic. You can find original sources, and accounts of historical events written by the people who experienced them. In a few minutes you can pull up the entire text of the U.S. and British official investigations.⁵ In the past, a single copy of an unpublished memoir, letter, or testimony was often buried in a dusty library stack. Such material is gradually being scanned and placed on the Internet for all to see. In the future we hope that original papers and unpublished data from cold fusion experiments will be made available. When the information you want is not available on-line, the Internet can still help. Online bookstores list nearly two hundred books about the Titanic. The Internet is a marvelous research tool, unprecedented in scope, speed, and ease of use.

It would seem that authors like Goldberg no longer have an excuse for making egregious mistakes. Unfortunately, although the Internet is a treasure trove of accurate information, it is also a junkyard of mistakes, misinformation, propaganda, and urban myths. It is an uncensored, uncontrolled free-for-all. A search for Titanic may turn up a thoughtful, accurate article, or one filled with nonsense. The



Titanic, Southampton pier, April 10, 1912.

Photo courtesy of Titanic Incorporated Limited.

two may look equally authoritative and professionally formatted. Where does this leave an author like Goldberg? He wants to write a three hundred-page book in a reasonable amount of time. He cannot afford to spend days researching every topic. How can he distinguish good information from bad? People often make three suggestions:

First, use your best judgment; go with what sounds reasonable. The problem is that truth sometimes sounds unreasonable, and defies the judgment of experts. This advice is unfair to Goldberg, because he probably does not have much judgment when it comes to marine technology in 1912. Like a reporter, he must act as a generalist, and describe subjects with which he is unfamiliar. Perhaps we should advise authors to "stick to a narrow range of subjects you know about." This would make history books dull, and newspapers impossible.

Second, stick to Internet pages from mainstream, authoritative publishers such as *Britannica*, the *New York Times*, and *Scientific American*. The authors at these sites are usually diligent, intelligent, and well-paid. They have high standards, and large libraries to draw on. But they are human beings, with prejudices and limitations. They sometimes despise, ignore, shortchange, or misrepresent a topic, such as they have with cold fusion.

Third, go with the most popular site. The latest Internet search tools automatically rank web pages by the number of links from other pages. Even so, the majority opinion is not always correct.

These techniques are not foolproof. In the end, you must depend upon your own judgment. If you cannot tell a reciprocating engine from a turbine, perhaps you should refrain from writing about the Titanic. Reporters, historians, and scientists who know nothing about electrochemistry and calorimetry should refrain from writing about cold fusion. If a reporter must write about cold fusion, he should search the Internet for articles about it. We are pleased to note that many search tools bring up our web site, www.infinite-energy.com, at the top of the list. A reporter starting there need not trust our judgment. We include a list of original sources: peer-reviewed scientific papers available at university libraries. A reporter who does not understand these papers must do his best with summaries written for the layman, and admit to his readers that he does not fully grasp the technical issues.

When a scientist writes about cold fusion, he should be held to more exacting standards. He must not dismiss or condemn cold fusion without reading the journal papers, and without presenting a credible, technical reason for doubting those papers. Society relies upon scientists, lawyers, ship captains, and other professionals to make unbiased, informed statements about their areas of expertise. It is unethical for a scientist to endorse or condemn a claim he has not carefully analyzed.

In rare cases, a few scientists have been guilty of even more unethical behavior. McKubre and other prominent cold fusion scientists have given copies of journal papers to prominent critics, including Douglas Morrison, Robert Park, and John Huizenga. The papers directly contradict assertions made by the critics regarding matters of fact, not opinion, such as the amount of energy produced by cells in continuous bursts, the percent of input versus output, or the amount of chemical energy that a mass 0.5 grams of palladium deuteride will release as it degasses. Morrison often claims the degassing can account for the heat produced during an experiment performed by Fleischmann and Pons. Fleischmann gave him a paper showing conclusively that he is mistaken by a factor of 1,700.⁶ Morrison has been told about this mistake countless times, at conferences, in writing, and in a formal reply published in *Physics Letters A*. Yet he recently contacted a Nobel laureate and repeated the same misinformation. Fortunately, the Nobel scientist contacted me, and I was able to give him the correct numbers.

Gary Taubes is another prominent critic. He made many misinformed claims in his book, on the radio, and in the mass media. He may not be qualified to read journal papers, because he does not appear to understand basic concepts such as electricity. He claims people sometimes measure electrolysis amperage alone and not voltage, and he thinks that regulated power supplies put out more electricity over the weekend because factories use less power. He thinks some researchers measure tritium once, after the experiment, without establishing a baseline or taking periodic samples. His book is filled with hundreds of similar errors. Perhaps the most mind-boggling one was his statement that a cell might have huge temperature gradients, "say fifty degrees hotter on one side than the other."⁷ This is like asserting that you might stir a cup of coffee, drink from the right side and find it tepid, but when you turn the cup around and drink from the left side, it will be steaming hot.

Taubes wrote his book using the same methods employed by sensation-mongering reporters in 1912: he pieced together second-hand rumors and made wild guesses about a subject he does not understand. He described his methods in the introduction, footnotes, and appendices. The book is based upon interviews and telephone conversations with 257 people, listed in an appendix. He spoke with seventeen people who actually performed experiments. Four of the seventeen are implacable enemies of cold fusion, including the authors of the three famous "negative" experiments. Most of the remaining 240 are critics like Frank Close and William Happer, who deplore cold fusion, and have staked their reputations on its demise. They have attacked it in the mass media, the ERAB report, and in books. Although more than a thousand peer-reviewed papers were published by the time Taubes wrote the book, he did not reference a single one of them in the footnotes. His descriptions of the experiments

Reporters, historians, and scientists who know nothing about electrochemistry and calorimetry should refrain from writing about cold fusion. If a reporter must write about cold fusion, he should search the Internet for articles about it.

are wildly at variance with the facts, in major and minor details, so it seems unlikely that he read a paper. Describing an experiment is an exacting task, even when you understand electricity, you read the paper, visit the lab, and ask the experimenter to review your description. When a scientifically illiterate person tries to imagine how an experiment works based on allegations made by people who despise the research, indescribable confusion and distortion result.

Taubes' book was recommended in enthusiastic blurbs by four Nobel laureates and the chairman of the American Association of the Advancement of Science. These people could not have actually read the book, or if they did, their judgment was skewed by animosity. This shows how easy it is to spread false information, and how careless distinguished scientists can be. It takes only a small group of people to poison the well of public opinion. There may be a few other active critics in the mass media, but most attacks originate from these four: Morrison, Park, Huizenga, and Taubes. They are not famous or influential. They succeed because many scientists bear a grudge against cold fusion, and are willing to believe the worst about it. When Robert Park attacked it with inflammatory *ad hominem* rhetoric, a room packed with hundreds of members of the American Physical Society (APS) applauded and cheered.

Mistakes Caused by Culture, Denial, and Psychology

One way to learn how to separate fact from fiction is to study the ways mistakes and disagreements arose in the first place, and why they remain in the historical record, seemingly impervious to correction.

What caused people to distort the Titanic story? Trauma, at first. People could not bring themselves to believe the news. An accident was bad enough, but it must have been heart-breaking and infuriating to read about the "millionaires' special" lifeboat No. 1, with a capacity for forty people, which was launched holding only "Sir Cosmo, Lady Duff Gordon and ten other people," leaving twenty-eight others to die in agony for no reason. Many distortions were caused by a spooky romanticism characteristic of the times. The truth was sickening; the romantic myth was comforting. People searched for meaning and inspiration in a seemingly random event. Two-thirds of the first class male passengers sacrificed themselves to rescue women and children, and they were celebrated as heroes.⁸ Some surviving officers testified that the men stood back bravely and the crowds were orderly. Other witnesses said there was chaos, violence, and disorganization

and that the crowds were quiet at first only because no one told them the ship was doomed. The treacly version has dominated most movies and the popular imagination. In 1912, George Bernard Shaw wrote:

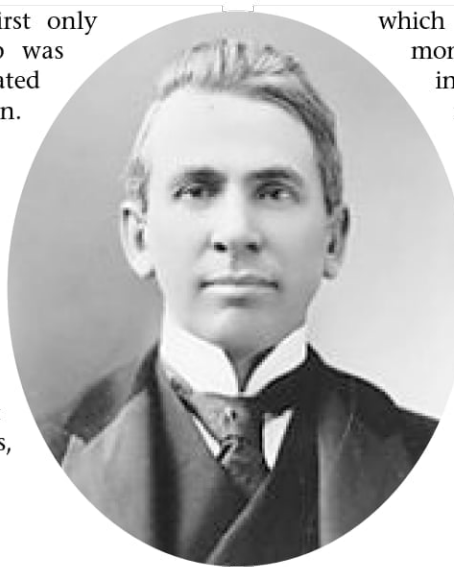
Why is it that the effect of a sensational catastrophe on a modern nation is to cast it into transports, not of weeping, not of prayer . . . not of poetic expression of soul purified by pity and terror, but of wild defiance of inexorable fate and of undeniable fact by an explosion of outrageous romantic lying? . . . What is the use of all this ghastly, blasphemous, inhuman, braggartly lying? Here is a calamity which might well make the proudest man humble and the wildest joker serious. It makes us vainglorious, insolent, mendacious. The effect on me was one of profound disgust, almost of national dishonor. Am I mad?⁹

Sea captain and author Joseph Conrad said, "There's nothing more heroic in being drowned very much against your will, off a holed, helpless, big tank in which you bought your passage, than in quietly dying of colic caused by the imperfect salmon in the tin you bought from your grocer."¹⁰

Some mistaken ideas about the disaster have more sinister origins. Reporters were looking for lurid "scoops." While some were inventing romantic myths, other demonized the capitalist ship owners, or invented horror stories. They invented tales and passed them off as news, the way Taubes invents magic temperature gradients. The American press described the survivors as they came aboard the rescue ship Carpathia as hysterical, suicidal, and "lunatic," when in fact the captain of the Carpathia said they were "magnificent . . . Calm and perfectly orderly." False rumors were published that workmen were still finishing up construction on the lower decks, and the water-tight doors could not be closed.¹¹

When the story broke, outrage erupted all over America and Europe. The U.S. blamed the British government for lax regulations, and the British newspapers blamed the Americans for lurid misrepresentations and spreading false hopes with bogus radio messages. The owner of the ship, J. Bruce Ismay, had been on board and he survived. Many people blamed him for the disaster. They assumed he ordered the captain to break the speed record. Perhaps the worst error to come out of this stew of confusion, anger, and grief was the calumny heaped upon the principal American investigator of the disaster, Senator William Alden Smith. These attacks were not honest misunderstandings; they were politically motivated. The portrayal of Smith's role is repeated in many modern accounts. I have read several books about the disaster, but I know of only one, by W.C. Wade, that tells the full story and gives Smith the credit he deserves.¹²

Smith dug out the causes of the disaster, and then he pushed through new safety regulations. Other members of the investigating committee helped, but it was mainly Smith who vigorously fought against "stupendous opposition" (Senator Vandenberg) from the steamship companies, conservative newspapers, the British Board of Trade, the surviving officers of the Titanic (some of whom never forgave him for revealing their ineptitude), the Marconi company, and the New York Times Co.,



Senator William Alden Smith,
principal American investigator of the Titanic disaster.

which had a sweetheart deal with Marconi to monopolize news of the disaster. These powerful interests fought to hide the facts and derail reform. They did not want to be held liable. They feared having to pay millions of dollars in restitution to the families of the victims. They did not want to pay to hire additional radio operators, or equip ships with enough lifeboats. Above all, they did not want a landlubber like Smith telling them how to run their business.

Opposition began within hours of the accident. The U.S. Navy intercepted confidential White Star line telegrams sent by Ismay from the Carpathia, and handed them over to Smith.¹³ Ismay and other company officials planned to bundle off the surviving officers and crew back to England the moment they arrived in New York, to keep them from testifying.

Smith and his deputies boarded the Carpathia when it docked and served subpoenas on the witnesses, forcing them to stay in the U.S. When the investigation got underway and Smith began revealing the ugly truth, the vested interests launched a propaganda campaign against him. Some newspapers, especially in England, were happy to go along. (Many other newspapers came to his defense.) His opponents made Smith look like a fool, with tactics similar to those used against cold fusion scientists, especially quoting out of context, oversimplifying, and ridiculing a person because he knows more than you do. One of the most famous attacks on Smith, often reprinted today,¹⁴ came after this exchange during the testimony of a surviving officer, Harold Lowe:

Senator Smith: Do you know what an iceberg is composed of?

Mr. Lowe: Ice, I suppose, sir.

This response "convulsed the audience with laughter," and it was reported in many newspapers as proof that Smith was an ignoramus. Here is what followed:

Senator Smith: Have you ever heard of an iceberg being composed not only of ice but of rock and earth and other substances?

Mr. Lowe: No, sir; never.

Senator Smith: Did you hear the testimony of your fellow officer, Boxhall?

Mr. Lowe: No, sir.

Senator Smith: You did not hear him describe what composed an iceberg?

Mr. Lowe: No, sir.

Senator Smith: But you labor under the impression that they are composed entirely of ice?

Mr. Lowe: Absolutely, sir.

The reporters should have latched on to the implications of the exchange. They did not ask what was the true meaning of this exchange, and the circumstances behind it. At least they could have asked Boxhall or one of the Navy experts present at the hearings what icebergs are made of. Here is the story behind this question. On the morning the news of the disaster hit, Smith began energetic steps to arrange a Congressional investigation. He consulted with leading experts on North Atlantic navigation and arctic con-

ditions. Weeks later, when he questioned Boxhall and Lowe, Smith knew that icebergs in that part of the ocean, at that time of year, often contain "rock, earth and other substances." Boxhall was an experienced North Atlantic seaman, so he also knew this. The other surviving officers and men had no idea what icebergs are composed of. Smith asked this question to screen Lowe's knowledge. The question was brilliant; it seemed ignorant only to those who were themselves ignorant. Smith asked many other incisive questions about the North Atlantic, such as why sailors were ordered to keep a log of water temperature, and what it means when the water or air temperature drops suddenly, as it did a few hours before the accident. He knew that a sudden drop in water or air temperature indicates the presence of ice floes. Most of the surviving Titanic officers and men did not know this.

To the critics, ice was ice, and that is all you need to know about it. Smith understood that an iceberg is a complex object, and its appearance tells of weather, geology, and massive forces that move megatons of materials over land and sea. Pathological skeptics often view the world in simple, black-and-white terms. When they are not aware of complexity, they are sure it cannot exist. They never thought that an iceberg might have internal structure, history or contamination. By coincidence, cold fusion critics often make the same mistake about palladium. Richard Blue and others ridicule cold fusion scientists for saying there is "good palladium" and "bad palladium." Blue thinks that when you describe a sample as 99.999% pure palladium, that's all there is to it. He does not know that the remaining 0.001% trace elements might include catalysts that enhance or poison the reaction. He never imagines that the crystalline structure of the metal, the voids and cracks, and microscopic surface roughness might affect conventional electrochemical reactions, hydride formation, and cold fusion. He does not know that a sample of palladium has a history of temperatures, pressures, cover gas composition, and cooling, rolling, and cleaning. This history affects performance. Anyone who studies electrochemistry, metallurgy, surface catalysis, material science, or the history of semiconductors would know these things, but the skeptics resolutely refuse to study any pertinent field. They insist that a metal lattice is simple and fully understood, and that "pure palladium" is a complete description down to the last atom, and all samples of pure palladium must perform the same way in all experiments. Some skeptics go to extremes, lumping together branches of the periodic table. During ICCF-3, Morrison objected to the claim that palladium reacts with deuterium, but nickel reacts with hydrogen. He said, "metal is metal: nickel or palladium, it's the same thing." He added later: "If these effects are real, why don't we see them in heavy-water ice?" The skeptics cannot imagine that a featureless polished metal sample may be as unique as a snowflake on the microscopic scale, and on the atomic scale, it may be as complex and mysterious as a star.

Smith's dogged, low-key style gave reporters the impression he was stupid. An experienced prosecutor, he was in the habit of asking the same questions over and over again, politely but forcefully wearing down the resistance of a hostile witness.¹⁵ Thanks to Smith's tenacity we learned, for example, that the lookouts on the Titanic's mast had been issued binoculars on the first leg of the voyage, but when the ship left Queenstown, an officer took the binoculars away. Although the lookouts repeatedly complained and requested binoculars, the officers did nothing. The surviving lookout,

Frederick Fleet, testified that if he had had binoculars he would have seen the iceberg in time to save the ship. Experts like Admiral Peary said that binoculars are essential in calm conditions at night in ice floes. Smith reached a clear-cut, commonsense conclusion: a regulation must ensure that lookouts will be issued binoculars.

Charles Lightoller

The man who opposed Smith most vociferously in public was Charles Lightoller, the senior surviving officer of the Titanic. The history books have treated him too kindly. This is a nuanced story. It would not be fair to portray Lightoller as a stereotyped villain. He was a brave man, a skilled mariner, and a hero at sea in both World War I and World War II. The captain of the Titanic was to blame for the disaster. But the officers failed to stay alert, be aware of iceberg warnings, and make sound recommendations to the captain. Lightoller played a prominent role in the investigations, and he spoke with authority and self-confidence. He personifies the tragedy. His supercilious attitude, his refusal to admit mistakes, and his blind refusal to accept commonsense safety measures—especially ones proposed by landlubbers—are symptomatic of the problems that led to the disaster. He and his captain made the worst mistake in nautical history, but he could not bring himself to admit it. When asked why they did not slow down, he testified:

Lightoller (L): You see we were making for a vicinity where ice had been reported as you say year after year, and time and again, and I do not think for the last two or three years I have seen an iceberg although ships ahead of us have reported ice time and time again. There was no absolute certainty that we were running into an ice-field or running amongst icebergs or anything else, and it might have been as it has been in years before ice reported inside a certain longitude.

(In other words, if you cannot prove with absolute certainty you will enter a danger zone, you should not slow down.)

Commissioner (C): I can understand that; it does not follow that because ice is reported you are going to have a collision with an iceberg.

L: That is what I wish to convey.

C: I take it then that your position is to justify the conduct of the Captain and those who were navigating the Titanic from 11 o'clock till the collision?

L: Yes.

C: In going ahead at 21½ knots, although you all knew that you were in the presence of ice?

L: Well, you hardly state it correctly when you say we knew we were in the presence of ice. We did not, we only had reports to go on.

C: You had no reason to disbelieve those reports.

L: On the contrary we had, having so many years gone across and never seen ice though it is repeatedly reported.

C: I suggest to you it would have been a much safer thing to have believed the reports which you had from a number of sources as to the presence of ice, than to have acted in disregard of the warnings you had received from other ships, and gone ahead at the rate of 21½ knots an hour until the collision occurred.

L: In the view of after events, of course, we form a totally different opinion. It would naturally have been safer, we can see now, not to have gone ahead at all.

C: And that is what, at all events, in the light of your present knowledge, good seamanship would have dictated?

L: Not necessarily good seamanship.
 C: Extra good seamanship?
 L: No, not seamanship at all.
 C: In the light of the experience you have had, it is what you would do now?
 L: In the view of our reports we have had in other voyages, if I say in the light of good seamanship or extra good seamanship, we should have stopped, the thousands of ships that have crossed the Atlantic would likewise have stopped, and then you come to the end of your tether.
 C: I do not say they would have stopped.
 L: Well, or slowed down. . .

In other words, slowing down to avoid ice would render North Atlantic navigation untenable and impossible. Any step to improve safety must end with all the ships at sea paralyzed and motionless, "at the end of your tether." Lightoller takes a practical, commonsense suggestion, postulates that it must be carried to irrational extremes, and from that he demonstrates that the suggestion cannot be implemented at all. This sort of illogic is rampant in debates about cold fusion, particularly when experts respond to irritating, unwelcome suggestions made by amateurs. They start out cautioning the amateur that instruments such as calorimeters have a margin of error, and calorimeters frequently malfunction with leaking cooling fluid and other problems. When the expert senses the message is not getting through, and the amateur still believes that cold fusion calorimetry indicates real excess heat, the frustrated expert may resort to extreme, untenable claims, such as a statement that no calorimeter has an error less than 10%, when in fact the error margin for top-quality conventional instruments is on the order of 0.1%. Or he may wave his hands and say calorimeters are so undependable that you cannot run one for more than a few days without recalibrating, when in fact a good one will run reliably for months.

Lightoller's quibbling and evasions went to eerie extremes:

C: You said something a moment ago, "As you know now" or "in view of what has happened." May I take it with the knowledge that you have now, and in view of this accident, what you would do now would be to slacken speed, or stop?

L: In view of what has occurred naturally we shall take every precaution that suggests itself to our minds in the future to avoid a repetition of such an accident.

C: Would not one of the precautions be what Captain Smith said to you on the bridge between nine and ten, "we should have to go very slowly"?

L: He was speaking about haze.

C: I know he was speaking about haze, but is not that what you should have done in adopting precautions?

L: No, I do not see it. It would have cleared the accident, I quite agree with you, had we been going very slowly, but we have to take in view the experience of years, what we have always done. . .

C: . . . you said that since the accident with the knowledge that you now have, you would have adopted extra precautions, I mean, at all events, from half-past nine onwards. Would not one of those precautions be going very slowly—diminishing speed?

L: I am afraid I cannot give you any definite answer to that. . .

C: What I want to suggest to you is that it was recklessness, utter recklessness, in view of the conditions which you have

Some mistaken ideas about the disaster have more sinister origins. Reporters were looking for lurid "scoops." While some were inventing romantic myths, other demonized the capitalist ship owners, or invented horror stories.

described as abnormal, and in view of the knowledge you had from various sources that ice was in your immediate vicinity, to proceed at 21½ knots.

L: Then all I can say is that recklessness applies to practically every commander and every ship crossing the Atlantic Ocean.

C: I am not disputing that with you, but can you describe it yourself as other than recklessness?

L: Yes.

C: Is it careful navigation in your view?

L: It is ordinary navigation, which embodies careful navigation.

C: Is this your position, then: that even with the experience of the Titanic disaster, if you were coming within the near vicinity of a place which was reported to you to be abounding in ice, you would proceed with a ship like the Titanic at 21½ knots?

L: I do not say I should. . .

C: At nighttime, and at a time when the conditions were what you have described as very abnormal, surely you would not go on at 21½ knots?

L: The conditions were not apparent to us in the first place; the conditions of an absolutely flat sea were not apparent to us till afterwards. Naturally I should take precautions against such an occurrence.

C: And what precautions would you take if you would not slow up or slow down?

L: I did not say I would not slow up.

C: Cannot you say whether you would or not?

L: No, I am afraid I could not say right here what I should do. I should take every precaution whatever appealed to me. . .

In the end, the Board ignored Lightoller, and ordered ships to slow down or alter course in ice floes.

These dithering discussions, the horrifying mistakes made by the Titanic crew, and the rules that allowed steamships to go to sea without enough lifeboats combine to give the impression that British seafaring was in crisis and the Board of Trade was run by idiots. This was not the case. Most sailors were skilled, and most ships arrived safely despite the myriad dangers of the sea. The Board performed badly in the hearings because it was under duress. Like many conservative organizations, it functioned well enough under normal circumstances, but badly in a crisis when the public demanded swift change. We should not exaggerate the Board's negligence, or the surviving officers' intransigence. The testimony was not all as infuriating as the sections quoted above. Board members asked many sharp questions. In the end, the Board pulled itself together and made sensible recommendations, includ-

ing enough lifeboats for all passengers and crew, and a twenty-four hour radio watch, although it neglected other important steps. Today, institutions like the APS are competent, although perhaps plodding and conservative. They make incremental scientific progress, which is a vital contribution to society. The APS has failed to respond to the challenge of cold fusion, because cold fusion is very different from conventional breakthroughs like high-temperature superconductivity or the discovery of planets circling distant stars.

For many years before the disaster, the Board of Trade knowingly allowed ships to sail without enough lifeboats. After the disaster, some steamship companies fought proposed regulations to increase the number of lifeboats. From our perspective, this seems like self-destructive behavior, as if they wanted to murder passengers and incur ruinous liability. Yet shipowners were not ignorant, or blinded by avarice. The weight of lifeboats reduced the payload and fuel economy; companies that did not carry enough gained a competitive advantage. Titanic designer Carlisle said, "Until the Board of Trade and governments of other countries require sufficient lifeboats to be carried, shipowners cannot afford such extra top weight."¹⁶ In 1912, experts pointed out, correctly, that in most emergencies such as storms, lifeboats would be useless. The boats were open, with oars, and in bad weather they would be swamped, capsized, or lost in fog. (Advanced modern lifeboats are much more survivable, being enclosed, motorized, self-righting, equipped with radios, and so on.)¹⁷ The experts in 1912 thought of lifeboats the way we would think of a plan to supply parachutes to all passengers in a jumbo jet. It is not practical or cost-effective.

Cover-up, Denial, Whitewash, Blaming the Messenger

How did people behave after they made the worst mistake in history and accidentally killed 1,400 people? Some, like Captain E.J. Smith, refused to put on a life jacket, and deliberately went down with the ship. Some tried to learn from the experience, and worked to prevent similar mistakes. Some, including Lightoller, seemed to learn nothing, and admit no regrets. For the rest of his life, Lightoller blamed the messenger, Senator Smith. He said the hearings were "Nothing but a complete farce, wherein all the traditions and customs of the sea were continuously and persistently flouted."¹⁸ If it ever becomes generally known that cold fusion is real, how will the scientists who opposed it react? A few may take responsibility and go down with the ship, retiring from academic life. I hope that most will regret their actions, and try to prevent such a thing from occurring again. Some will react the way Lightoller did, blaming Pons and Fleischmann. They may say the traditions and customs of science are more important than experimental results. Lightoller, in effect, put traditions and customs ahead of the lives of passengers. To him, "the experience of years" and "what we have always done" outweighed all practical suggestions as to what we might do instead, to avoid killing thousands of people. It seems that many scientists believe the processes and niceties of doing science are more important than exploring a discovery which might benefit millions of people.

Some institutions react to trauma by reforming. Others go extinct. Even those which reform may pretend nothing has happened. They hide a scandal in plain view. The Board did this by focusing on a narrow set of questions framed in advance of the hearings, to which they supplied reassuring answers. Here are some examples:

"Was the Titanic supplied with proper charts?" The Board said Yes.

"Was the Titanic sufficiently and efficiently officered and manned?" Yes.

"Before leaving Queenstown on or about 11th April last did the Titanic comply with the requirements of the Merchant Shipping Acts, 1894-1906, and the rules and regulations made thereunder with regard to the safety and otherwise of 'passenger steamers' and 'emigrant ships'?" The board answered Yes, which was technically correct. It did not say this proves the requirements were inadequate, obsolete, and a major contributing factor to the disaster.

Elsewhere the Board reached absurd conclusions:

"(a) Were binoculars provided for and used by the lookout men? (b) Is the use of them necessary or usual in such circumstances?" After pages of meandering discussion, and after hearing Lightoller testify he would "much prefer" not to give the lookouts binoculars, the board answered No, and No. The Titanic's designers must have thought otherwise, since they included a box in the lookout station to store binoculars. The surviving lookout, Frederic Fleet, said he could have saved the ship with them, and U.S. experts agreed with him, but the Board thought not.

"Was proper discipline maintained on board after the casualty occurred?" Yes.

"Were the boats swung out, filled, lowered, or otherwise put into the water and got away under proper superintendence?" The Board said Yes. Everyone else said No, boats launched half-empty were not "under proper superintendence." One wonders how sparsely loaded the boats would have to be before the Board would call it "improper supervision." Perhaps it would have objected to boats set adrift empty?

"Were the boats sent away in seaworthy condition and properly manned, equipped, and provisioned?" "Manned" here means the boats had the requisite number of sailors in charge; the Board did not dispute the fact that the boats did not carry enough passengers. The Board concluded, "The fourteen lifeboats, two emergency boats, and C and D collapsible boats were sent away in a seaworthy condition, but some of them were possibly undermanned. The evidence on this point was unsatisfactory." This was a flat-out falsehood. Testimony proved beyond doubt that the boats were ill-equipped and that many were manned by untrained crew members, in some cases stewards instead of sailors. (See the Smith quote, below.) One of the collapsible boats was sent away capsized, because the launching equipment was inadequate. Perhaps it was in good condition, but surely not in a seaworthy state.

"Did each boat carry its full load; and if not, why not?" The answer was No. The Board explained:

1. Many people did not realize the danger or care to leave the ship at first.
2. Some boats were ordered to be lowered with an idea of their coming round to the gangway doors to complete loading.
3. The officers were not certain of the strength and capacity of the boats in all cases.

People did not realize the danger because Captain E.J. Smith did not tell them the ship was doomed, even though he knew it ten minutes after the accident. The captain told a few top officers and ordered them to keep it a secret to prevent panic, as if it could have been kept secret indefinitely. Someone may have had the "the idea" of coming around to the gangway

doors, but no orders were issued, the maneuver was not carried out, and some experts doubt it could have been carried out. The comment about "strength and capacity" refers to the testimony of the officers in charge of loading lifeboats. They said they thought the boats might buckle in the middle while being lowered fully loaded with their rated capacity of sixty people. They quibbled about this at great length during the hearings. Their objection makes no sense. They should have known that in 1912, engineering was advanced enough to ensure that a brand-new lifeboat would not break in half when fully loaded. The Titanic was the most expensive and best-equipped ship ever made, not an old tub with rotting lifeboats. When they realized the ship was sinking, the officers loaded the lifeboats fully. They were untrained, unprepared, and unfamiliar with the lifeboats and other equipment. Most British crews were much better. During his investigation, Senator Smith went aboard the Olympic while it was docked in New York. He asked the captain to perform an impromptu lifeboat drill. Within fifteen minutes, a boat had been prepared, loaded with sixty crewmen, and lowered into the water in perfect order.¹⁹

Senator Smith's report was the unvarnished truth. Smith drafted and pushed through effective reforms, ensuring enough lifeboats, regular lifeboat drills, a radio operator on duty twenty-four hours a day, improved watertight construction, better pumps, and much else.

Men have not grown wiser since 1912. The arguments made today in debates about cold fusion and the California power crisis are as misguided as those made by the Titanic officers. We are blind to irrationality in present debates because the issues are not settled yet, the facts are not in, standards have not been set. We see the mistakes made by Titanic officers because we are the beneficiaries of Smith's reforms, which raised our expectations. No officer or passenger on a ship today would have cause to imagine that a lifeboat, when properly manned and lowered, might break in half!

In contrast to the Board's anodyne assurances Smith wrote:

The Titanic boats were only partially loaded and in all instances unprovided with compasses and only three of them had lamps. They were manned so badly that, in the absence of prompt relief, they would have fallen easy victims to the advancing ice floe . . . One witness swore that two of the three stewards in her boat admitted that they had never had an oar in their hands before and did not even know what the oarlock was for. The lifeboats were filled so indifferently and lowered so quickly that, according to the uncontradicted evidence, nearly 500 people were needlessly sacrificed to want of orderly discipline in loading the few that were provided. There were 1,324 passengers on the ship. The lifeboats would have easily cared for 1,176 and only contained 704, 12 of whom were taken into the boats from the water, while the weather conditions were favorable and the sea perfectly calm. And yet it is said by some well-meaning persons that the best of discipline prevailed. If this is discipline, what would have been disorder?

What would have happened if Smith had not investigated? Critical facts would have been concealed, and lost forever. Naturally, there would have been reforms, but they would

It seems that many scientists believe the processes and niceties of doing science are more important than exploring a discovery which might benefit millions of people.

have been half-hearted, incremental, and ineffective compared to the sweeping changes Smith pushed through. The larger impact of the disaster would have been blunted. Society's hubris would not have been so effectively punctured. It was largely thanks to Smith that society fulfilled the pledge he proposed:

. . . the sea is the place permanently to honor our dead; this should be the occasion for a new birth of vigilance, and future generations must accord to this event a crowning motive for better things.

We want a new birth of vigilance in physics today. The quiet catastrophe we have lived through with cold fusion has been nothing like the Titanic disaster. No one has drowned, or been hurt. At worst, people's careers have been derailed and their reputations sullied. Yet if it turns out that cold fusion can be made into a practical source of cheap energy, then the consequences of the twelve-year delay in launching serious, large scale research will turn out to be worse than the Titanic disaster. During the twelve-year hiatus, more people may have perished for lack of energy and clean water than ever drowned in shipwrecks.

If we prevail in this fight for cold fusion, we must strive to prevent this sort of thing from happening again, at least for a few generations, until the shock wears off. Perhaps the greatest danger in studying the Titanic is that you may be lulled into a false sense of superiority. We must not imagine that we are immune to suicidal mistakes. We will not run a ship into an iceberg at high speed, thanks to regulations and radar. But we will discover many new ways to commit mayhem. Look at the damage we do to the environment, the Chernobyl accident, our stockpiles of nuclear weapons. Look at a crowd of physicists cheering and applauding derisive attacks on cold fusion at the APS. Let us hope our descendants do not look back at the cold fusion debate, read the statements by Taubes—which are more wrongheaded and reckless than anything Lightoller said—and conclude that they will never be so stupid.

Perhaps the most disturbing aspect of the Titanic aftermath was that so much depended upon Smith. A haunting question confronts us in our predicament: Why must society so often depend upon a lone, crusading hero: a William Alden Smith, Margaret Sanger, or Medgar Evers? What will happen to cold fusion if a hero does not arrive in time? What other breakthroughs have been forgotten, how many other opportunities were squandered, because no champion stepped forth?

References and Sources

A note on sources: Because the disaster is so copiously documented and controversial, nearly every statement in this essay is backed by several sources, and probably contradicted by others. Items of common knowledge, such as the fact that no large gash has been found in the wreckage, are not docu-

mented. Most assertions here are backed by what I consider the three most reliable sources: Wade, the Senate transcript, and Board of Trade transcript. I apologize if I have not foot-noted every assertion the reader doubts or wishes to follow up on. The statements by Dick Blue were repeated on the Internet many times. The APS members' applause for Park and Morrison's comments at ICCF-3 are my own recollections.

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3. Board of Trade investigation. C. Lightoller testified that White Star Line ships were not run at top speed during the first year of operation.
4. Wade, W.C. 1986. *The Titanic: End of a Dream*, Penguin Books, p. 41, and Board of Trade. Carlisle also contacted the Board of Trade, the Merchant Shipping Advisory Committee and other authorities during the design phase of the Olympic and Titanic, recommending more lifeboats. Carlisle was browbeaten and treated as a hostile witness by the Board, proving that no good deed goes unpunished.
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8. Two-thirds of the third class children also died, but they were not proclaimed heroes. The exact numbers were 57 out of 174 first class men rescued, 27 out of 79 third class children rescued.

Titanic references continued on page 69



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New Energy Companies and Inventors

Status Reports on Technologies and Claims

This is the second in what will be a continuing series of updates on the activities and achievements of new energy companies, organizations, and inventors.

Fusion Power, Inc.

Dr. Les Case
P.O. Box 495, Greenland, NH 03840 USA
Phone: 603-772-9200 • Fax: 603-772-9200

Dr. Case announced his catalytic fusion process at ICCF-7 in Vancouver in 1998. Since then, it has been successfully replicated multiple times by SRI International, with the conclusion that helium-4 is produced, commensurate with the excess heat generated in this joule-heated, gas-phase process. Case continues to work on developing a self-sustaining reaction in a dewar vessel, while also pioneering new methods to enhance the process. He is strongly driven in the direction of commercial applications.

See *Infinite Energy* Nos. 19, 20, 22, 23, 25, 26, 28, 32

HydroDynamics, Inc.

8 Redmond Court, Rome, GA 30165 USA
CEO: Kelly Hudson
Phone: 706-234-4111 • Fax: 706-234-0702
www.hydrodynamics.com

The company sells the patented HydroSonic™ Pump, which is an over-unity thermal energy producer. More thermal energy has been measured coming out of this water-cavitation device than electric power entering an electric motor, which turns the cavitating rotor in a water chamber. The device is useful in either steam or hot water applications. The company does not, at present, make claims of over-unity power production, though it is well aware of this property. Instead, the technology is successfully sold in various environmentally beneficial applications, such as to remediate toxic waste or to accomplish bulk heating of fluids without creating harmful surface contact heating.

See *Infinite Energy* Nos. 5/6, 23, 31

Global Atomics Corporation (Formerly, International Fission Fuels)

30 South Weatherby Drive, Meridian, ID 83642-6268 USA
CEO: Dr. Paul Brown
Phone: 303-307-6707 • Fax: 303-766-3713
www.globalatomics.com

The company is focused on the patented process of using gamma radiation to transmute high-level radioactive waste while simultaneously obtaining net energy production. The process does not rely on any "new physics"—gamma ray "photonuclear remediation" is novel but understood physics. The company is in the process of forging commercial alliances with organizations within Russia. There is talk of the company being publicly traded in the relatively near term.

See *Infinite Energy* Nos. 21, 27

Crystal Energy, Inc.

127 West James Road, Thousand Oaks, CA 91360 USA
CEO: Harry Taplin
Phone: 805-495-1684 • Fax: 805-494-1338

"Nuclear augmented combustion" has been in experimental and commercial development since the 1980s. It is the process by which the addition of lithium-based catalysts appear to significantly enhance the per/kilogram energy release of hydrocarbon fuels, while simultaneously reducing pollutants. Harry Taplin, a respected authority on combustion testing, continues to pursue avenues toward commercialization. Some commercial trucking fleets have begun to use the process, but it has been very difficult to awaken the world to the reality of this remarkable technology.

See *Infinite Energy* Nos. 18, 31, 34

New Energy Research Laboratory ♦♦♦ Device and Process Testing Update

Ken Rauen and Eugene Mallove

First Gate Energies' Sonofusion Reactor: Initial Validation at 50% Excess Heat

Success is especially sweet when one has been trying for a long time, without much success, to identify and develop a robust demonstration device for cold fusion phenomena—excess heat and nuclear effects. Such a device now appears to be close at hand in the sonofusion reactor of Roger Stringham and his colleagues at First Gate Energies. In mid-February Ken Rauen, as lead investigator, succeeded in reproducing the approximate excess heat results that Stringham had obtained in the same reactor when it was in his California lab (see *IE*, No. 35, p. 21, p. 70). Figure 1 is a sample of one stretch of excess power, varying with the unknown conditions on the surface of a copper foil target in heavy water. This was under pulsed acoustic dual-transducer activation with approximately 40 kHz wave packets.

With a margin of error in the preliminary result that we believe to about ± 0.5 watt (certainly no more than ± 1 watt), we have high confidence that excess heat has been faithfully reproduced. We have confidence in the joule heater calorimetric calibration of both the input acoustic signal oscillator electronics and the reactor itself, which has a built-in joule heater calibration. Given the experience of Stringham in producing similar results on demand over many years, we believe this is an excellent candidate to be a robust demonstration of cold fusion phenomena. Many new experiments need to be performed, including attempts to reduce or zero the excess heat by employing ordinary water and some other metals, reducing argon pressure, lowering input power below a critical value, etc. (The excess heat is said to be so frequently part of any such sonofusion reactor work, that in this instance the best “null” is found by cross checks on the calorimetry; we have already carried these out.)

Though much work remains to be done in getting onto market with this scientific demonstration device, First Gate Energies has agreed to allow NERL to be the exclusive developer, marketer, and distributor of scientific demonstration educational kits based on Stringham's “M3S” sonofusion reactor.

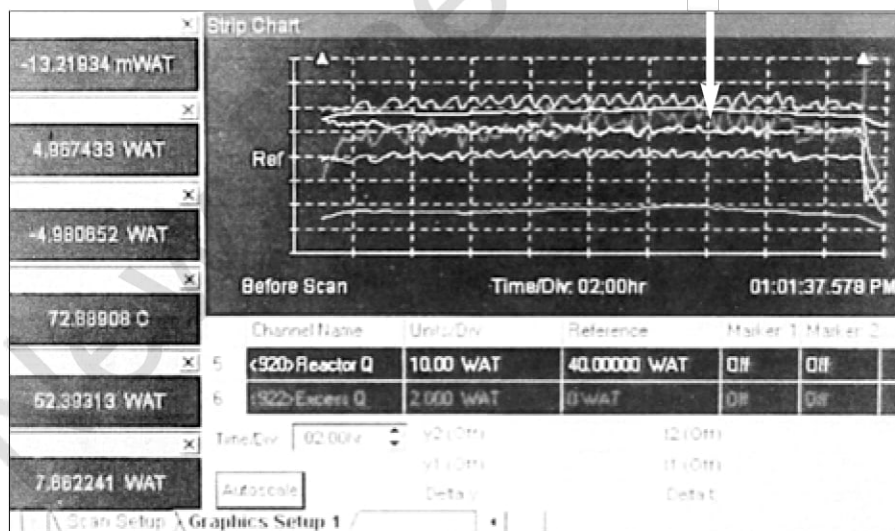


Figure 1. Sample of one stretch of excess power. The excess heat line is marked with an arrow and appears darker than the adjacent lines. The “Ref” line on the Y axis is zero watts excess heat. Vertical scale is 2 watts/division. The cyclic fluctuations are due to furnace cycling to keep the lab warm, as it is winter New Hampshire.

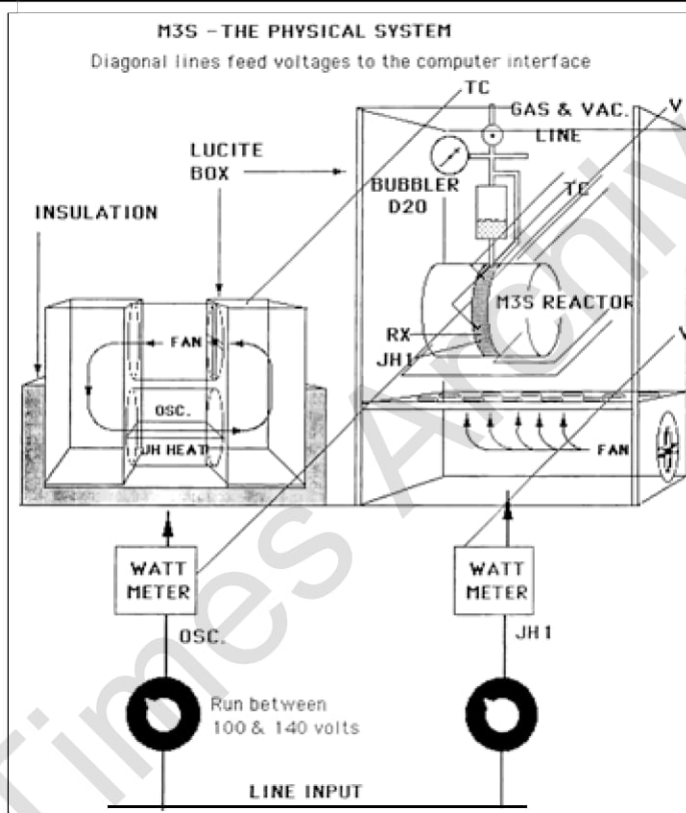


Figure 2a. Set-up schematic of sonofusion reactor.

(Those who would consider obtaining such a research kit are asked to contact NERL as soon as possible, to establish priority and help us anticipate production runs. Note well: We will not distribute such kits until we are certain that we can *guarantee* excess heat results on demand.)

The road to successful confirmation was not easy. After Eugene Mallove's visit last fall to the First Gate Energies laboratory in California, Roger Stringham sent to NERL in Bow, New Hampshire the M3S sonofusion reactor, its plexiglass test stand, and its transducer electronics calorimeter. The set-up can be seen schematically in Figures 2a and 2b. A picture of the full system at NERL with our Toshiba laptop computer data acquisition system appears in Figure 3 while it was producing excess heat on February 17. The reactor seals had developed leaks from prolonged use by Stringham and perhaps from the transport. During various stages of replacing seals, leaks and input power losses occurred, in one case due to ultrasonic power absorption in soft-rubber replacement seals; we reverted to teflon seals.

Our data acquisition system software is Benchlink™ (by Agilent/HP), which allows up to twenty-two channels of thermocouple and input power measurements via an Agilent/HP 34970a Data Acquisition Switch Unit, which periodically scans all input channels.

The very first run of the sonofusion reac-

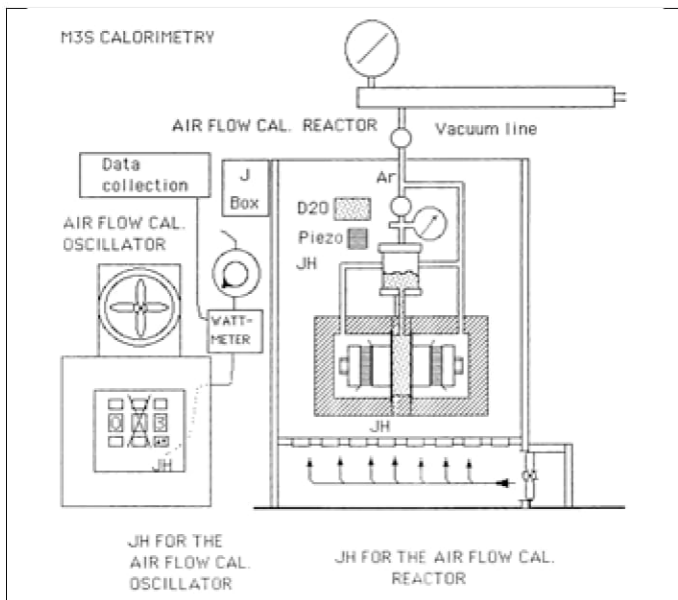


Figure 2b. Set-up schematic of sonofusion reactor.

The very first run of the sonofusion reactor, *with* the new teflon gaskets, produced excess heat with good confidence. The excess power was initially 2.5W, with about 5W of ultrasonic energy into the reactor (5 watts in, 7.5 watts out). From the calibration runs and from two control tests during the run, we are confident that the error margin of this experiment is about 6 0.5W.

As a confidence check, Ken Rauhen turned off the oscillator electronics and moved the oscillator cooling loop thermocouple from the calorimeter box to the piece of steel which houses the ambient temperature recording thermocouple; there was a mere 0.15°C difference. The associated excess heat error is no more than +/- 0.2W, as expected in this zeroing of input. Later, after a day or more of operation, the excess heat increased to a higher level—up

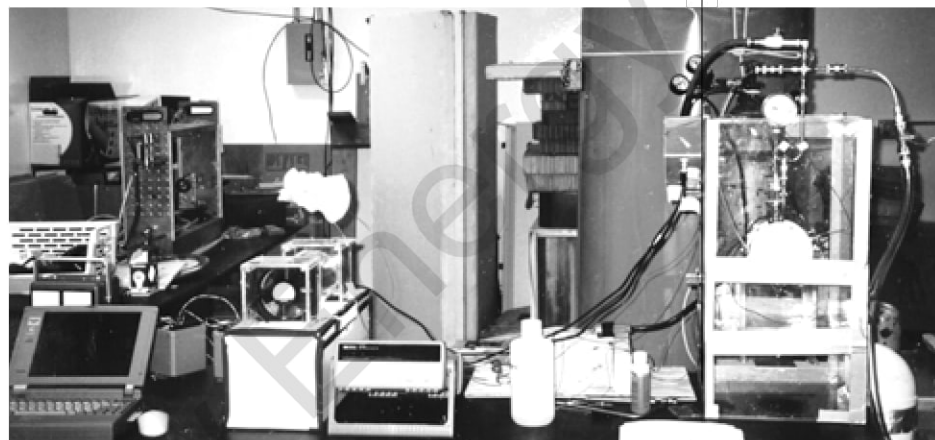


Figure 3. Stringham set-up.

Photo by Eugene Mallove

to 8 watts, but it also dipped periodically, though never approaching zero. We know that for an unknown reason reactor calibration changed, so our confidence in the 100% figure is not good.

The thermocouple was then replaced into the oscillator electronics calorimeter with oscillator power off. The oscillator calorimeter without its circulation fan cools very slowly. It was allowed to run overnight to see if the temperature difference would drop to zero. It went to 0.2°C, which results in about 0.5W of excess heat calculated. We discount this zero

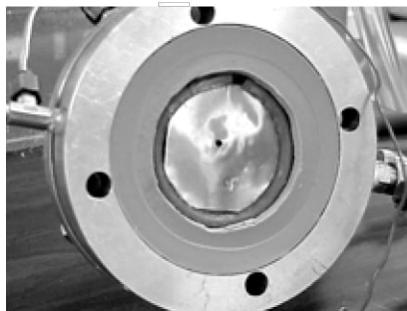


Figure 4. Thin copper target showing hole.
Photo by Ken Rauhen

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check, as the offset is not an offset in the heat calculation; the equation is nonlinear. The placement of the two thermocouples in the same environment is a better check of the system in our opinion. The next step was to increase the reactor heater power to reach temperatures seen by Roger Stringham as necessary for good performance. The first excess heat run was about 95 to 100°C, possibly too cold for optimal cold fusion. Better results were found at 108°C.

We intend to redesign the system for the educational kit such that an *accurately known* bias joule heater power of over 50 watts is not required to keep the reactor at operating temperature. This

can be done by appropriate insulation to make the reactor self-heat. We also intend to perform gas sampling in order to detect the helium that Stringham has previously reported emanating from this reactor. Scientific demonstration kits will have gas sampling facility provided with them so that gas can be sent for testing for helium at centers with quadrupole mass spectrometers that are suitable for such refined testing.

A curious phenomenon occurred in initial testing, before we detected excess heat. The thin copper target that Stringham had provided to us developed a small hole in it! Such holes had previously been reported in sonofusion targets, but usually with attendant visual evidence of melting. This target (5 mil thickness) had rough edges under microscopic examination that were unlike those in simple tearing of copper sheet of the same thickness (see Figure 4).

Later, we observed the central perforation of the copper target with which excess heat was detected. This time there was evidence of surface thermal and mechanical damage. Fertile ground for investigations of many kinds. □□□

“Occult Chemistry”: The Amazing Phenomenon of Extra-Sensory Perception of Nuclear Structure and Subatomic Particles

Mahadeva Srinivasan*

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Occult Chemistry Re-Evaluated

How would you react if someone were to tell you that he has come across compelling evidence which seems to indicate that some “clairvoyants” possessing remarkable psychic abilities (or “siddhis”) have apparently “directly observed” and documented in detail the nuclear structure of all the ninety-two naturally occurring elements, down to the “quark” and even “subquark” level? And that they also have observed, employing only their extraordinary mental faculties, the existence of isotopes of several elements much before the “official” scientific discovery of isotopes by Aston in 1912 using his newly invented mass spectrograph. To top it all, you are told that all this was done almost a hundred years ago! Chances are that most readers and certainly anyone claiming to be a “rational scientist” would dismiss all this as complete nonsense. Perhaps one should first listen to the whole story before passing any judgment.

The origin of this extraordinary story goes back almost a century, to the year 1895. The two clairvoyants who did this work were the eminent theosophists Annie Besant and C.W. Leadbeater, who died in 1933 and 1934 respectively. Between them, Besant and Leadbeater have authored several dozens of books on various esoteric and spiritual topics, such as “The Ancient Wisdom,” “The Life After Death,” “Astral Plane,” “Reincarnation,” and so on. Annie Besant was also deeply involved in the freedom movement in India and, in fact, was elected President of the Indian National Congress in 1917. Some readers may also be aware that it was Besant and Leadbeater who “discovered” the renowned philosopher J. Krishnamurthi when he was barely twelve years old, being impressed by the “brilliant aura” around him, and predicted that this boy would grow up to be a world teacher.

Besant and Leadbeater were therefore persuaded by A.P. Sinnett, a close friend, to employ their psychic powers to try to find out if there exists an ultimate constituent particle or atomic building block of which all matter is composed. This quest, which began in August 1895, seems to have been pursued by them off and on for almost forty years, right until Besant’s demise in 1933.

Their first studies were directed towards the common gases of hydrogen, oxygen, and nitrogen, and a report on this was published in the November 1895 issue of *Lucifer*, the journal of the Theosophical Society in London. In 1908, the work done over the previous dozen years was compiled, edited, and published in the form of a book titled *Occult Chemistry*. The second edition of *Occult Chemistry* was brought out in London in 1919 and the third revised and enlarged edition (400 pages, with 230 illustrations), edited by C. Jinarajadasa, appeared in 1951. Jinarajadasa, an M.A. from Cambridge University, was associated with Besant and Leadbeater from the very inception of occult chemistry studies. He was responsible for taking down notes and preparing sketches when Besant and

Leadbeater described their observations of the structures of atoms and molecules during the psychic sessions. (Remember, there were no tape recorders in those days!)

One of the central and crucial observations made by Besant and Leadbeater was that a hydrogen atom was composed of eighteen subatomic particles which they christened as “Ultimate Physical Atoms” or UPAs. Likewise, they reported that the atoms of other elements also comprised identical types of UPAs whose numbers increased in multiples of eighteen. Note that much of all this was done well before Rutherford’s discovery of the atomic nucleus in 1911—in other words, before the dawn of the “nuclear era”!

In the early 1920s came the highly successful Bohr-Schrödinger model of the atom, according to which a hydrogen atom comprised a single proton around which orbited a single electron. Thus there was no way that science could accommodate eighteen particles in a hydrogen atom or for that matter 4,267 particles in a uranium atom which the clairvoyants had apparently painstakingly counted! The observations of Besant and Leadbeater as described in *Occult Chemistry* were therefore dismissed by the scientific community as totally unacceptable, and so their monumental work was consigned to gathering dust in remote corners of theosophical libraries, and for all practical purposes all but forgotten and lost to the world, at least for the next seventy or so years.

During the mid-1970s, a theoretical physicist from Cambridge University in England, Stephen Phillips, who was carrying out Ph.D. studies in particle physics at the University of California in Los Angeles (UCLA), came across a copy of the book titled *Physics of the Secret Doctrine* by Kingsland, wherein there was a diagram of the hydrogen atom as seen and recorded by Besant and Leadbeater.

Physicists will recall that in 1963 a breakthrough in understanding elementary particles and nuclear structure came about through the postulation of a class of subnuclear particles called “quarks,” independently by Gell-Mann and Zweig. When Phillips saw Besant’s diagram of the hydrogen atom he was astounded beyond belief as he realized that these clairvoyants had given out the “quark” and indeed the “subquark” structure of the nucleus as early as in 1895! (The concept of a “subquark” has not been accepted by modern physics even today, although it has been postulated by Stephen Phillips and a few other theoreticians in scientific publications.) Phillips was so fascinated and overwhelmed by the exhaustive studies of Besant and Leadbeater that he immediately embarked on a detailed analysis and interpretation of their findings, culminating in the publication of his 250 page book, titled *Extra-Sensory Perception of Quarks*, in 1980.

A simplified monograph titled “Occult Chemistry: Re-evaluated” was published in 1982 by Dr. Lester Smith, a Fellow of the Royal Society (FRS), based on Phillips’ work. For the benefit of the non-specialist, I am going through all this historical background only to impress upon the reader that a tremendous amount of documented literature exists on the subject for anyone deeply interested.

The method of investigation adopted by Besant and

Leadbeater, as described by them, is possibly familiar to Indian readers acquainted with yogic literature. According to Jinarajadasa (and Phillips), in Aphorism 3.26 of the "Yoga Sutras" of Patanjali, reference is made to the siddhi known in sanskrit as "Anima," which says that a Yogi can attain through in-depth training the ability to "acquire knowledge of the small, the hidden or the distant by directing the light of the superphysical faculty." He can apparently exercise this siddhi (referred to in occult chemistry literature as "micro-psi") while in an



Dr. Annie Besant

altered state of consciousness in which he experiences visual images of objects too small for human sight to discern. These observers have stated that "micro-psi" can be induced or terminated at will by the trained observer, who can, with practice, also alter their power of magnification.

In 1991, a Canadian, Ronald Cowen, who has been practicing a Buddhistic form of meditation for several years, after undergoing rigorous training under a learned Buddhist monk, came across Phillips' book *Extra-Sensory Perception of Quarks*. With a bit of effort he soon found that he too could visualize "Micro Physical Atoms" and their constituent UPAs similar to the diagrams he saw in Phillips' book, and started corresponding with Phillips. In the summer of 1992 when Phillips became convinced that Ronald Cowen was probably seeing "genuine nuclear images," he proceeded to Toronto with eight sealed glass capsules containing samples of the first eight elements of the periodic table (hydrogen, helium, lithium, beryllium, and so on). Ronald Cowen not only identified the elements in each of the capsules, he was also able to reproduce many of the observations of Besant and Leadbeater.

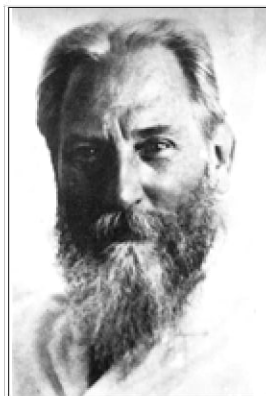
In another experiment, Phillips set up an electrical circuit with a battery and a remote switch which could alter the direction of flow of current in a wire. Ron was able to identify the direction of the flow of current in 79% of the trials without prior knowledge of it. Besides, Ron appears to have done something which Besant and Leadbeater had not done, namely for the first time, using his "micro-psi" faculties, he has provided a detailed description of the structure of a single electron. This is something that physics even today has not been able to do! This work of Ronald Cowen has been summarized by Stephen Phillips in a preliminary report entitled "Recent Clairvoyant Observations of Subatomic Particles" in late 1992.

This writer had the opportunity to meet in person both Ronald Cowen at Toronto and Stephen Phillips in London in April 1994, and discuss with them the present status of "occult chemistry" research. In the second and third parts of this article, a brief description of "clairvoyant nuclear findings" to date will be presented along with their analysis and interpretation in the context of the current picture of the ultimate structure of matter as expounded by Stephen Phillips in his various occult chemistry related publications.

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Pre-empting the Discovery of Isotopes

The first part of this article was a historical introduction to the subject of "occult chemistry" and "extra-sensory perception of quarks." Two eminent theosophists, Annie Besant and Charles Leadbeater, possessing extraordinary "clairvoyant"



C.W. Leadbeater

powers, arrived in India around the turn of the last century and took up residence at Adyar (a suburb of Madras) in the estate of the headquarters of the Theosophical Society. Employing their remarkable psychic faculties, they embarked on an ambitious program of studying and documenting in detail the structure of the atoms of all the elements of the "periodic table," besides several crystals, chemical compounds, and complex molecules. The famous English chemist, Sir William Crookes, who invented the cathode

ray tube (which forms the heart of the television set you watch every day) and who was himself also a theosophist, provided Besant and Leadbeater with pure samples of several of the uncommon elements.

Early on during their "micro-psi" investigations, Besant and Leadbeater observed that different specimens of the same element were composed of identical microscopic objects which they named as "Micro Physical Atoms" or MPAs. They presumed that MPAs were atoms of the particular element under study, in their normal state, undisturbed by the act of random selection and psycho-kinetic (PK) perturbation. (We will see later that according to Phillips' analysis this assumption was incorrect.)

The MPAs of elements as they appeared to them during "micro-psi visualization" comprised of symmetrically arranged groups of particles or "points of light" bound together in such rapid, complex orbital motion that they presented initially only a blurred unfocused image. But with practice and using a "special form of will-power" they could slow down their motion sufficiently to observe the details. Throughout the investigations Leadbeater specialized in the study of the geometrical arrangement of the constituents of the MPAs and in identifying and counting their number while Annie Besant examined the configuration of the "lines of force" linking and holding together groups of particles. These investigators could tune the magnifying power of their micro-psi vision over a wide range and thereby resolve the images of particles into clusters of "points of light," each of which were discerned to be discrete three-dimensional objects. As the structure and configuration of each of these ultimate objects were identical, independent of the element under study, they surmised that these were the fundamental building blocks of all matter, and called them as "Ultimate Physical Atoms" or UPAs.

At this point it is worth distinguishing between MPAs and UPAs. Besant and Leadbeater presumably identified MPAs with what physicists now refer to as the "nucleus" of the atom, although in 1895 when they first commenced their investigations Rutherford had not yet discovered the atomic nucleus. There were as many MPAs as there are elements. UPAs on the other hand are the subnuclear particles of which all nuclear matter is made. As observed by Besant and Leadbeater there is essentially only one type of UPA but this occurs either as a "male" (or positive) version or a "female" (or negative) version, which are mirror images of each other.

The clairvoyant investigators found that the MPAs of different elements had different shapes. Interestingly, barring a few exceptions, the shape of an MPA was correlated with the position of the element in the "periodic table" of elements. (The reader may refer to any elementary textbook on atomic

physics or physical chemistry to know more about the Periodic Table of Elements if they wish.) Thus the MPAs of all elements belonging to a particular group of the periodic table and consequently possessing similar chemical properties have similar shapes. The seven shapes into which the MPAs were categorized are titled by them as: "spike," "dumb-bell," "tetrahedron," "cube," "octahedron," "bar," and "star." The geometrical symmetry of the MPAs simplified Leadbeater's task of counting the number of UPAs in an MPA, considering that the heavier elements had several thousands of UPAs in their MPAs. By 1908 when the first edition of *Occult Chemistry* was published, Besant and Leadbeater had examined nearly sixty elements and altogether by the end of their monumental research work spanning thirty-eight years they had recorded for posterity the details of 111 MPAs.

Besant and Leadbeater had counted eighteen UPA particles in the Micro Physical Atom (MPA) of hydrogen. A striking feature of their observations was that the number of UPAs increased approximately in multiples of eighteen as the atomic weight of the element increased. By the turn of last century science had progressed so much that the atomic weights of most of the elements of the periodic table had been determined on a scale normalized to unity for hydrogen. When Besant and Leadbeater found that for several elements the number of UPAs in an MPA was an integral multiple of eighteen, they divided the number of UPAs counted by eighteen to obtain an estimate of the "atomic weight" of the elements. The book *Occult Chemistry* compares the micro-psi atomic weight so obtained (specified to the second decimal place) with the scientific atomic weight, and points out the remarkable agreement between the two.

Atomic No.	Element	Symbol	Number of Atoms	Number Weight Hydrogen Scale	Scientific Atomic Weight Hydrogen Scale	External Form
1	Hydrogen	H	18	1.00	1.00	Ovoid
	Adyrium	Ad	36	2.00	—	Ovoid
	Occultium	Oc	54	3.00	—	Ovoid
2	Helium	He	72	4.00	3.97	Star
3	Lithium	Li	127	7.06	6.89	Spikes
4	Beryllium	Be	164	9.11	8.94	Tetrahedron
5	Boron	B	200	11.11	10.73	Cube
6	Carbon	C	216	12.00	11.91	Octahedron
7	Nitrogen	N	261	14.50	14.90	Ovoid
8	Oxygen	O	290	16.11	15.87	Ovoid
9	Fluorine	F	340	18.88	18.85	Spikes
10	Neon	Ne	360	20.00	20.02	Star
	Meta-Neon	mNe	402	22.33	—	—
11	Sodium	Na	418	23.22	22.81	Dumb-bell
80	Mercury A	Hg	3576	198.66	199.1	Tetrahedron
	"B	—	3600	20.00	—	—
81	Thallium	Tl	3678	201.33	202.8	Cube
82	Lead	Pb	3727	207.06	205.6	Octahedron
83	Bismuth	Bi	3753	208.50	207.6	Cube
84	Polonium	Po	3789	210.50	208.1	Tetrahedron
85	Astatine	At	3978	221.00	208.1	Dumb-bell
86	Radium	Rn	3990	221.66	220.2	Star
	Meta-Radium	—	4032	224.00	—	—
87	Francium	Fr	4006	222.55	221.2	Spikes
88	Radium	Ra	4087	227.06	224.3	Tetrahedron
89	Actinium	ac	4140	230.00	225.2	Cube
90	Thorium	Th	4187	232.61	230.3	Octahedron
91	Proto-actinium	Pa	4227	234.83	229.2	Cube
92	Uranium	—	4267	237.06	236.02	Tetrahedron

Besant and Leadbeater studied the atoms of elements systematically in increasing order of atomic weight starting from hydrogen. When they reached neon (element number 10) they were puzzled to observe that there were two varieties of neon MPAs having a slightly different number of UPAs each, namely 360 and 402. They called these "neon" and "meta-neon" and recorded their micro-psi atomic weights as 20.00 and 22.33 by dividing the number of UPAs in the MPA by eighteen. Similar behavior was noted in the MPAs of argon,

krypton, xenon, and even platinum. The scientifically minded readers may have guessed by now that Besant and Leadbeater had essentially stumbled upon the phenomenon referred to by atomic science as "isotopes," five years before Aston's discovery of the same in 1912 using his newly invented instrument known as the mass spectrograph!

From the observed shapes of the MPAs and the deduced micro-psi atomic weights, these investigators were able to place the element under study properly in the periodic table of elements. In most cases, when the identity of the element was known to them already, the above method confirmed that their observations were accurate. In a few cases however the elements they investigated were not listed in the periodic table and in fact there were unfilled gaps in the table in the relevant locations. Thus these clairvoyant researchers accidentally discovered five elements which were unknown to science at the time of their work.

These elements which have since been identified by science are: promethium ("illanium"), astatine ("element number 85"), francium ("element number 87"), protoactinium ("element number 91"), and technitium ("masurium"). The names in parentheses are the names assigned by Besant and Leadbeater in their original publication.

It is thus obvious that these clairvoyants were surprisingly accurate in their estimates of atomic weights and the proper placement of the element studied in the periodic chart.

This remarkable success led them to conclude that their finding, namely that a hydrogen atom (or rather nucleus of the hydrogen atom) is composed of eighteen subatomic particles, must also be correct, even if it were not consistent with the scientific knowledge of their times. They tacitly assumed that science would eventually catch up with their findings. However, even taking into consideration the tremendous progress achieved by science in the area of elementary particle physics in recent years, the identity of the UPA is still not obvious. The credit for resolving this issue and reconciling the occult chemistry findings with modern physics goes to Dr. Stephen Phillips. We will examine in the third and concluding part of this series the identity of the Ultimate Physical Atom in the language of modern physics.

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Of Quarks and Sub-Quarks

It was pointed out in the previous articles on "occult chemistry" that Besant and Leadbeater's observation that a hydrogen atom comprises eighteen subatomic particles could not be reconciled with the contemporary concepts of nuclear physics since the inception of these studies. The identity of the Ultimate Physical Atom (UPA) described by them in detail puzzled Dr. Stephen Phillips, the English particle physicist who first came across this work in the mid-1970s when he was carrying out doctoral studies at the University of California in Los Angeles. After carefully analyzing the occult chemistry findings, Phillips has deduced that the Ultimate Physical Atom (UPA) seen by Besant and Leadbeater must be "sub-quarks" which, as already mentioned, modern physics has not yet discovered.

When I graduated with a physics degree in the mid-1950s, the nuclei of atoms comprised positively charged particles called protons and electrically neutral particles (of almost same mass as the proton) called neutrons. Since the mid-1960s physics has found that these "nucleons" in turn are made up of subnuclear particles called "quarks." There are supposed to be six varieties of quarks, of which the sixth and last quark, namely the "top quark" appears to have been

detected only a couple of months ago at the Fermi High Energy Accelerator Laboratory near Chicago in the U.S.

Of the six quarks, however, only two categories of quarks are involved in the constitution of stable atoms and normal matter, namely the "up" quark (or u-quark) and the "down" quark (or d-quark). The u-quark is a positively charged particle with a charge of $(+2/3)$ while the d-quark has a charge of $(-1/3)$. As per the so-called "Standard Model" of elementary particle physics currently in vogue, a proton and a neutron are each composed of three quarks with the difference that a proton is made of two "u"'s and one "d" while a neutron comprises two "d"'s and one "u."

I apologize to the reader for having to drag you into all this but in order to understand Phillips' analysis which leads to his conclusion that the UPAs seen by Besant and Leadbeater must be "subquarks," one has to first understand what "quarks" are. Remember that we are trying to arrive at the identity of the eighteen subatomic particles seen by the clairvoyants in a hydrogen MPA. Phillips has shown in his 1980 book *Extra-Sensory Perception of Quarks* that the mismatch between occult chemistry and modern physics can be resolved if the following two hypotheses are made while analyzing and interpreting the Besant-Leadbeater findings:

Hypothesis #1: The UPA is a subquark. For convenience, we denote the positive and negative UPAs by the symbols X and Y respectively. Phillips has hypothesized that the +ve subquark has a charge of $(+5/9)$ and -ve subquark a charge of $(-4/9)$. It follows that the "u" and "d" quarks comprise three subquarks each as follows $u = (X,X,Y)$ and $d = (X,Y,Y)$.

Hypothesis #2: The MPA of elements seen by the clairvoyants are not the nuclei of elements as existing in nature but instead are quasi-nuclear systems of nuclear, quark, and subquark matter formed from two nuclei of the element when subject to psycho-kinetic vision. Phillips refers to this as the "doubling up hypothesis." Physicists will appreciate that this hypothesis is consistent with Heisenberg's Uncertainty Principle, which essentially states that the very act of observation of any atomic system would perturb it and alter its state. The vital clue as to the true nature of the MPA was obtained by Phillips by carefully comparing the micro-psi version of the hydrogen atom (see Figure 2, p. 29), which is the smallest and simplest of all atoms, with the quark model of a proton, which physics knows is synonymous with the nucleus of a hydrogen atom. To appreciate the basis of Phillips logic it is worth reading the original description of a hydrogen MPA in the words of Besant and Leadbeater:

The first chemical element selected for examination was an atom of hydrogen (H). Looking carefully at it, it was seen to consist of six small bodies contained in an egg-like form. It rotated with great rapidity on its own axis, vibrating at the same time, the internal bodies performing similar gyrations. The whole atom spins and quivers and has to be steadied (by the use of "will power") before exact observation is possible. The six little bodies are arranged in two sets of three forming two triangles that are interchangeable. . . Each body had the appearance of a spherical cavity, denoted by circles, in an ambient transparent medium, rather like a bubble of air trapped in water. Each hole encloses a tightly bound cluster of three UPAs (indicated by circles enclosing (+) and (-) signs, whose significance will be discussed later). These groups of three UPAs or "hydrogen triplets" were arranged in two triangles called "hydrogen triangles," which interpenetrated and were linked to each other across space by lines of attraction.

Phillips suggests that each "hydrogen originates from a proton of a hydrogen molecule that came under micro-psi observation." Consistent with quark theory of modern physics one can now identify each "hydrogen triplet" as a quark. It is not obvious that the hydrogen MPA as seen by Besant and Leadbeater can be understood as comprising six quarks arising from the two protons of a hydrogen molecule, there being in all four u-quarks and two d-quarks in the hydrogen MPA. The eighteen UPAs of a hydrogen MPA now stand fully explained.

Phillips is emphatic in pointing out that the hydrogen MPA is not a molecule of hydrogen as known to science, but is a new nuclear product resulting from a sort of "heavy ion fusion" familiar to present day nuclear physicists. This is because the two triangles representing a proton each were noticed to always overlap each other, as shown in Figure 2, p. 29 whereas the two protons of a hydrogen molecule are separated by a distance which is about 100,000 times the size of a proton. (Phillips suggests that the hydrogen MPA is essentially a "bag" of six quarks predicted by the so-called "bag model" of strong forces between quarks.)

Before coming to the above conclusion, Phillips analyzed forty-eight MPAs which were published in *Occult Chemistry* with diagrams depicting the various observed stages of disintegration of all their multi-quark and multi-subquark bound states. The published diagrams of Besant and Leadbeater have enabled Phillips to identify every single particle in each of these MPAs in terms of "up" and "down" quarks present in their parent nuclei and their "subquark" constituents. Phillips claims, for example, that in the case of gold, the most populous MPA for which stage-wise disintegration diagrams are given by Besant and Leadbeater, he is able to account for every one of its 3,546 UPAs precisely!

Finally let us review very briefly what Besant and Leadbeater have said regarding the structure of an individual UPA. Figure 3 (see p. 29) depicts the positive and negative types of UPA which, as already mentioned, are mirror images of each other. As described in occult chemistry literature, the UPA consists of ten distinct closed curves or "whorls." Three of these are thicker and are called "major whorls." These spiral side by side in parallel bands over a roughly spherical surface making 2.5 revolutions each about the central axis, forming a "double helix." Flowing in the major whorls are "currents of different electricities." The minor whorls display to micro-psi vision the "seven colors of the rainbow." The UPA has the shape of a slightly flattened sphere; it may be described as being heart shaped. It spins and precesses like a top and also displays a regular pulsation, namely a contraction and expansion, again akin to the human heart!

Leadbeater has made a more detailed study of the structure of the UPA. He found that each of the ten whorls is a closed helical coil with 1,680 turns. (He claims to have checked this number meticulously by counting the number of turns in a whorl in 135 different UPAs selected from numerous substances!) Each circular turn of the whorl or first order spirilla is another helix made of seven smaller circular turns or "second order spirillae" and so on. There are in all seven orders of spirillae, each finer than the preceding one. A schematic representation of the fifth, sixth, and seventh order spirillae (not shown here) can be found in the 1951 edition of *Occult Chemistry*. The seventh and last order spirillae consists of seven "bubbles" spaced evenly along the circumference of a circle. Besant and Leadbeater have referred to these as the bubbles of "Koilon," which is a Greek word meaning hollow. Thus, they conclude that the UPA and hence all matter in the ultimate analysis, essentially consists of bubbles or holes in space—"like pearls upon an invisible string."

The use of the word "string" has been particularly highlighted by Phillips, who has gone on to elaborate further, linking the occult chemistry findings to "Super String Theory," which is about the hottest topic in particle physics today, leading us into the realm of the most contemporary concepts of nuclear matter.

All this is no doubt "mind-boggling." Some of the readers are probably inclined to dismiss such a detailed description of the UPA as a figment of imagination on the part of Besant and Leadbeater. In this context, it is worth pointing out that this description of the UPA has recently been independently confirmed by Ronald Cowen in the presence of Stephen Phillips in the summer of 1992 at Toronto as documented in the manuscript titled "A Report on Recent Clairvoyant Observations of Subatomic Particles," written by S.M. Phillips in late 1992.

A new feature of Ronald Cowen's observations is that he has also, for the first time in the history of micro-psi studies, provided a detailed description of a single electron. He finds that the structure of an electron is basically very similar to that of an UPA, and in the ultimate analysis, they are both made of bubbles in space, though there are some minor differences between an electron and a UPA. Ronald Cowen finds that these bubbles, both in the electron and UPA, are not spherical in shape but rather toroidal, like a doughnut. According to Cowen, this discrepancy between his observations and those of Besant and Leadbeater could be due to the fact that the bubbles are actually spinning and the toroidal shape is visible only when they are slowed down.

Before concluding this series of articles on the occult chemistry findings, I must make a few general remarks. First what I have described so far is only a very small portion of the totality of micro-psi observations, the tip of the iceberg so to speak. It turns out that the first persons to carry out such micro-psi examination of matter were not Besant and Leadbeater. The 1919 edition of *Occult Chemistry* refers to an earlier such study conducted by a man named Edwin Babbitt. I have personally seen in Babbitt's book, titled *Principles of Light and Color*, published in 1878, a diagram of what looks very much like the UPA of Besant and Leadbeater. Subsequently during the 1950s one more clairvoyant by the name of Geoffrey Hodson (of New Zealand) also conducted some studies of this nature. And now we have Ronald Cowen in Canada. So there have been at least five people in the last 120 years who are known to have had micro-psi vision. It seems very likely that there must have been other highly evolved "yogis" who probably have had such powers, but who perhaps either did not conduct such studies or did not both-

er to document their observations in a scientific manner like Besant and Leadbeater and others.

Another point to be noted is that these clairvoyants did not merely "see" or "observe" subatomic particles. They have apparently actually carried out a "step-wise nuclear disintegration experiment" starting from a molecule and ending up in a sub-quark. This implies psycho-kinetically imparting tremendous energy to the atomic system. To break the nucleus into its sub-quark components is something even the \$8 billion super-collider accelerator which was to have been the world's most powerful particle accelerator and whose construction was abandoned a few months ago by order of the U.S. Congress, could not have accomplished! How then did the trained human mind achieve this?

My purpose in writing this article is primarily to draw the attention of the public and scientific community, in particular, to the existence of this fascinating material.

If one accepts the occult chemistry findings as generally reliable, then many fundamental questions arise regarding mind and matter and its interaction. It is hoped that this article will stimulate a healthy discussion on this topic and open up new vistas for intellectual pursuits.

[In 1995, after this series of articles was published, the *Journal of Scientific Exploration* published a peer-reviewed article on this subject by Dr. Stephen Phillips, with critical comments by Dr. Y.H. Dobyns of Princeton University and Phillips' reply to Dobyns' comments. See JSE, Vol. 9, No. 4, 1995. Dr. Phillips also published a second book, *ESP of Quarks and Superstrings* (review follows).]

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About the Author



Dr. Mahadeva Srinivasan received his D.Sc. in physics from the University of Bombay in 1985. His research career spanned four decades at Bhabha Atomic Research Center (BARC). He was head of the Neutron Physics Division and subsequently Associate Director of the Physics Group of BARC. Dr. Srinivasan has also been involved in cold fusion experiments since 1989, playing a leading role in the BARC studies in this area. Since retirement in 1997 from BARC, he has been living in the southern Indian city of Chennai and serves in an advisory capacity to cold fusion researchers in India.

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ESP of Quarks and Superstrings

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The author of this book, Dr. Stephen Phillips, is a qualified theoretical physicist who first graduated from Cambridge University in England and subsequently from the University of California during the mid-seventies, where he carried out doctoral work in the area of theoretical particle physics. The term

"ESP" in the title of this book pertains to studies conducted through "Extra Sensory Perception" not by himself but two other people, namely Annie Besant and C.W. Leadbeater. Phillips' book examines the century old "clairvoyant" findings of Besant and Leadbeater on the structure and constituent subatomic particles of "atoms." In order to appreciate what this book is all about, it is instructive to first understand the background to this whole subject.

1) The original clairvoyant studies were carried out over a thirty-eight year period spanning from 1895 to 1933, by the two "theosophists" Besant and Leadbeater, who are known to have had remarkable psychic powers.

2) They employed a special mental faculty, first described in Patanjali's classic work (400 B.C.) *Yoga Sutras* as "Anima," the ability to "shrink ones consciousness down to the size of an atom at will and acquire knowledge of the small." (Anima is the first of

the eight "Siddhis" that a serious practitioner of Yoga is supposed to be able to acquire.)

3) Using this special type of "micro-psi" power, Besant and Leadbeater carried out a very detailed study of each of the ninety-two naturally occurring elements and even some of their isotopes.

4) The findings of their systematic studies starting from hydrogen (element #1) were initially published as articles in the journal *Theosophist* and later compiled in the form of a book titled *Occult Chemistry*, first published in 1908. The Appendix of Phillips' book gives a complete list of the original references.

5) The technique adopted by Besant and Leadbeater has been described in *Occult Chemistry* as follows: Besant would select an atom of matter randomly for study, and then using a "special form of will power" would disintegrate it in steps until she arrived at the "Ultimate Physical Atom" or UPA of which all matter is made. She thus counted the number of UPAs in an atom of each of the elements of the periodic table. (For example, she reported observing eighteen UPAs in an atom of hydrogen and 4,267 in one atom of uranium!)

6) When they came to element #10, neon, the theosophists found that some atoms had 360 UPAs while others had 402 UPAs. Thus the clairvoyants had discovered the existence of isotopes thirteen years before Aston's identification of isotopes using his mass spectrograph.

Phillips accidentally stumbled into occult chemistry literature during his student days in California and ever since has remained fascinated with it. He has spent the better part of the last quarter century trying to understand the identity of the UPA in the context of contemporary particle physics. This book is the outcome of Phillips' persistent quest. He has concluded that the UPAs seen by the clairvoyants must be subquarks not yet discovered by physics, after analyzing in great detail the step wise disintegration diagrams and complete descriptions of the subatomic particles making up what the clairvoyants thought were atoms, given in *Occult Chemistry* for forty-eight elements. Chapter 5 of his book, spanning over 150 pages, examines systematically the quantitative data provided by Besant and Leadbeater for each of these forty-eight elements.

Phillips has been able to account for each and every particle described by the clairvoyants by making only two assumptions: (a) That the UPAs described by them are subquarks; a positive subquark having a charge of $+5/9$, and a negative subquark having a charge of $-4/9$. (b) That an upquark is composed of two positive subquarks and one negative subquark, while a down quark is composed of two negative subquarks and one positive subquark.

Phillips presents very persuasive arguments in favor of the conclusion that the two clairvoyants indeed saw the subatomic particles they have claimed. He points out the "truly remarkable degree of consistency between these psychic observations and facts about the quark composition of atomic nuclei." However, he contests the claim of the clairvoyants that the Micro Physical Atoms or MPAs described by them are individual atoms of the elements as they exist in nature. Instead, Phillips is obliged to



You both have something in common. Dr. Davis has discovered a particle which nobody has seen, and Prof. Higbe has discovered a galaxy which nobody has seen.

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come to the inescapable conclusion that MPAs are artificially created "quasi-nuclear systems of quark and sub-quark bound states" formed out of the debris of two atoms of the element which break up following psycho-kinetic intervention of the clairvoyants' "will power." This way he is able to explain the eighteen UPAs in an MPA of hydrogen and also the approximate proportionality factor of eighteen between the number of UPAs observed in an MPA and the atomic number of the element under study.

Phillips then goes on to interpret the detailed description of an individual UPA given by the theosophists in terms of currently accepted concepts of superstring theory.

It is noteworthy that the Foreword to this book has been written by the distinguished Indian Nuclear Physicist and former Chairman of the Indian Atomic Energy Commission, Dr. Raja Ramanna who states: "If knowledge acquired through intuition has stood the test of time even after a hundred years then it is clear that the methodology employed by these people needs to be critically examined both from the point of view of 'disciplined consciousness' as well as the 'neurophysiological structure of our brain.'"

When the book *Occult Chemistry* was first published in 1908 it was dismissed as "utter nonsense," as its findings were totally at variance with the picture of the atom and nucleus that was prevalent at that time. The painstaking work of Dr. Stephen Phillips has revived interest in this fascinating century-old work. His analysis and conclusions clearly vindicate the validity of the clairvoyant observations to a large extent. The reader of this book is left with the sobering thought that the human mind has indeed demonstrated its superiority over matter in a very convincing manner. Phillips has dwelt at great length on the implications of the *Occult Chemistry* findings to man's view of nature and reality. □□□

Extrasensory Perception of Subatomic Particles

Stephen M. Phillips*

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A century-old claim by two early leaders of the Theosophical Society to have used ESP to describe subatomic particles is evaluated. Their clairvoyant observations are found to be consistent with facts of nuclear physics and with the quark model of particle physics, provided that it is hypothesized that they described not atoms (as they assumed) but quasicompound nuclear systems formed prior to observation by an induced disintegration of two atomic nuclei and by the subsequent interactions of all their released constituents. The two Theosophists' account of the force binding together the fundamental constituents of matter is shown to agree with the string model version of quantum chromodynamics. The physical implication of these remarkable correlations between ostensible, paranormal observations of subatomic particles and facts and ideas of nuclear and particle physics is that quarks are not fundamental (as many physicists currently believe) but, instead, are bound states of three preons or subquarks.

Introduction

Two teams of physicists at Fermilab, the particle accelerator near Chicago, U.S.A., announced in March of this year that they had at last found the missing member of the third generation of quarks. This discovery appears to have completed the story of the century-old search for the basic types of matter—apart, that is, from its possibly still unread postscript containing their predicted supersymmetric partners and the shadow matter particles required by superstring theory. But is this discovery of the last quark really only the end of a chapter? This article discusses unorthodox evidence that the full story has yet to unfold in that the ground level in the hierarchy of complexity of matter—molecules, atoms, etc.—has still to be reached.

A problem facing acceptance of paranormal phenomena by the scientific community is that, confronted by evidence that violates well-established laws of nature or contradicts presuppositions of science, people will always find it easier to doubt the honesty of the researcher reporting these controversial phenomena than to accept his evidence as genuine. However, what if a psychic claimed to see objects so small that science at the time neither knew anything about them nor possessed the technological capability to study these things? Suppose that science later verified too many of his observations to make it plausible that his success in describing the objects was due only to chance? Whether sufficiently rigorous protocols were applied, whether the psychic cheated, or whether the researcher might have fabricated or altered his data would no longer be pertinent issues for believers in the paranormal and its skeptics to argue about because the lack *at the time* of scientific information about the things the psychic claimed to see would have made cheating by anyone impossible in principle. Demonstrating knowledge of some supersensory aspect of the world that is confirmed by advances in science many years later is, arguably, the most convincing type of ESP because this cir-

cumstance permits the skeptic no room for doubt or rational explanation if the correlations between scientific facts and psychic observations are so precise and numerous as to make lucky guessing improbable in the extreme. This article will examine a rare example of such ESP in which ostensible, paranormal descriptions of atoms and subatomic particles published about 100 years ago have turned out to be confirmed by facts of nuclear physics and particle physics.

Micro-Psi Investigations

Books on yoga often refer to eight psychic powers, or "siddhis." One of these is "minuteness—the power to be as small as an atom at will" (Wood, 1965). In his *Yoga Sutras*, the first exposition of yogic philosophy, Patanjali (circa 400 B.C.) states that a yogi can acquire "knowledge of the small, the hidden, or the distant by directing the light of a superphysical faculty" (Taimni, 1965). This siddhi has the Sanskrit name of "anima." In parapsychological terms (Puthoff and Targ, 1979), the ability to acquire "knowledge of the hidden or the distant" is remote viewing of the world at large, while the ability to obtain "knowledge of the small" is remote viewing of the microscopic world and has been given the name of "micro-psi" (Phillips, 1980). Among the few who have publicly claimed micro-psi ability were Annie Besant (1847-1933) and Charles W. Leadbeater (1847-1934), two early leaders of the Theosophical Society. After a short period of intensive training in Kundalini yoga, they collaborated intermittently between 1895 and 1933 in investigations (Besant and Leadbeater, 1908, 1919, 1951) of the microscopic structure of matter, using their micro-psi faculty to study atoms of all the elements. Leadbeater looked first at gold but, finding its structure too complicated, examined hydrogen and atmospheric nitrogen and oxygen. During a summer vacation, he visited a museum in Dresden, Germany, where he was said to have used his micro-psi ability to study many minerals on display there. Besant and Leadbeater asked Sir William Crookes, the famous chemist, to provide specimens of some elements difficult to obtain in a pure state. By 1907 they had examined fifty-nine more elements, noticing variations in the supposed atoms of neon, argon, krypton, xenon, and platinum even though scientists did not suspect then that an element could have more than one kind of atom. For example, Besant and Leadbeater reported in 1908 in the journal *The Theosophist* their discovery of a variation of neon. This was five years before the English chemist Frederick Soddy gave the name of "isotopes" to atoms of an element differing in mass. Their colleague, C. Jinarajadasa, who made sketches and notes during their investigative sessions, wrote in 1943 (Jinarajadasa, 1949) to Professor F.W. Aston, inventor of the mass spectrograph, informing him that Besant and Leadbeater had discovered in 1907 the neon-22 isotope by psychic means five years before scientists found it and twenty years before Aston himself separated it from the neon-20 isotope. (How the two Theosophists identified isotopes will be explained later.) Predictably unimpressed by

this unorthodox claim for priority, the scientist merely replied that he was not interested in Theosophy!

Besant's and Leadbeater's book *Occult Chemistry* summarizing their research was published in 1908. The next year they studied twenty more elements, notably so-called "illinium." They noted that it was the sixty-first element, indicating that it was the element promethium, found by science in 1945. A second edition of *Occult Chemistry* appeared in 1919, but it included no new material. Purported descriptions of the molecules of benzene, methane, and other chemical compounds were published in 1924. A year later, Leadbeater published a model of the atomic structure of diamond in *The Theosophist*. In 1926 the hexagonal arrangement of carbon atoms in graphite was correctly described. More material was published in 1932, including descriptions of the supposed atoms of so-called "element 85" (named "astatine" by science in 1940), "element 87" (called "francium" by science in 1939), and "element 91" (isolated by chemists in 1921 and called "protactinium"). Besant and Leadbeater had recorded in 1909 an element they called "masurium" and had placed it correctly in the periodic table. Leadbeater described it again in 1932, five years before it was detected and called "technetium" by science. In the same year Leadbeater reported (Besant and Leadbeater, 1951) finding atoms of an element with an atomic weight of 2. The Theosophists assumed (mistakenly, as it turned out) that it was an element unknown to science, and they did not correctly identify it as deuterium, which Harold Urey and his colleagues had discovered in the previous year. Finally, Jinarajadasa compiled all the research material that had accumulated over thirty-eight years and published it in 1951 in a third, enlarged edition of *Occult Chemistry*. It contained purported descriptions of 111 atoms, including 14 isotopes, and the molecules of 29 inorganic compounds and 22 organic compounds.

It is unfortunate that the publications of the two Theosophists never gave details about the nature of the chemical samples they examined, for this might have shed light on the question of how they could have detected prior to science supposed atoms of promethium, astatine, francium, and technetium—unstable elements which occur in nature only as very dilute trace contaminants. To argue, however, that the paucity of their abundance would have made this task of detection *impossible* begs the question of how micro-psi functions. For example, perhaps the descriptions of these short-lived elements was based not on single, chance observations but on many examinations of the same chemical sample, during which these rare atoms were occasionally noticed. According to Jinarajadasa's introduction to the third edition of *Occult Chemistry*, Leadbeater went often to the Dresden Museum during a holiday in Germany in 1907 and recorded mental pictures of the atoms in minerals displayed there, later examining his recorded images in more detail. Maybe he used this "play-back" facility to spot short-lived atoms. In the absence of any information about the modus operandi of micro-psi, it would be wrong to prejudge its capacity to detect atoms of rare, radioactive elements, however mathematically improbable it is that they could have been observed by chance.

Given that Besant and Leadbeater presumably knew of the gaps in the periodic table represented by these unstable elements, how can we be sure that their accounts were based upon real objects and were not fabricated according to their

expectations? Knowing which groups of the periodic table these undiscovered elements belong to could have enabled them to deduce what shape their atoms ought to have, having decided upon a rule to relate fabricated atomic shapes to the groups containing their elements. But the exact values of the atomic weights of these elements were unknown to science at the time when Besant and Leadbeater published their examination of them and yet the "number weights" (defined shortly) that they calculated for these elements agree with their chemical atomic weights to within one unit. It is highly implausible that this measure of agreement could have come about by chance in every case. Furthermore, analysis (Phillips, 1994) of the particles observed in the supposed atoms of these elements undiscovered by science at the time reveals such a high degree of consistency with the author's theory of micro-psi that neither deliberate fabrication nor hallucinations influenced by a knowledge of the gaps in the periodic table can plausibly explain why atoms of these elements seemed to have been detected paranormally before their scientific discovery. These two considerations strongly suggest that Besant's and Leadbeater's descriptions of these rare atoms must have been based upon *physical* objects, for there is no more plausible explanation for such measures of agreement.

Micro-Psi Atoms

The two Theosophists found different specimens of an element to be made up of similar objects. Assuming them to be atoms, they classified these structural units according to their shape into seven groups: spike, dumb-bell, tetrahedron, cube, octahedron, bars, and star (Figure 1). They claimed to find that the form of a "micro-psi atom" (MPA) correlated with the position of its corresponding element in the periodic table, *i.e.* all elements in the same group of the table

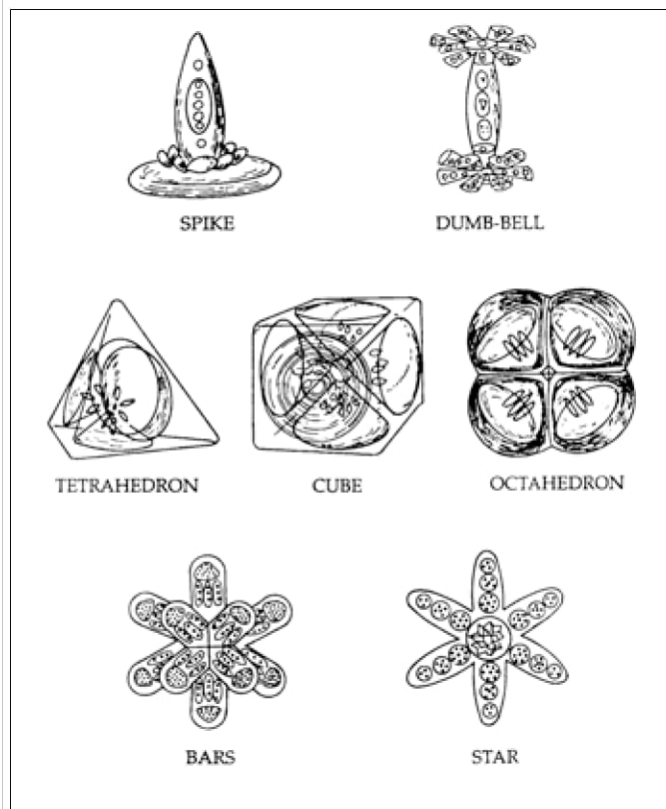


Figure 1. The seven types of MPAs.

(and therefore having similar chemical properties) had MPAs with similar shapes (Table 1). For example, all inert gases have star-shaped MPAs, placing them in the Star Group, while the divalent elements other than oxygen had tetrahedral MPAs, placing them in the Tetrahedron Group. This correlation enabled them to check their identification of MPAs. The skeptic might argue that this correlation is not evidence of the physical reality of MPAs because they could have known sufficient chemistry to either fabricate the correlation or influence the form of what were purely hallucinatory images. If, however, their preconceptions based upon their knowledge of the periodic table had *alone* determined the shapes of MPAs, *all* group IIA elements would be in Tetrahedron Group A (see Table 1), whereas one of these elements—magnesium—is actually in Tetrahedron Group B, whose MPAs have structures which are slightly different from those in Tetrahedron Group A. Moreover, all group IIIB elements would be in Cube Group B, whereas one—boron—is in Cube Group A, while all Group IVB elements would have been in Octahedron Group B, whereas they appear in both

subgroups. The fact that elements in the *same* subgroup of the chemical periodic table do *not* always occur in the *same* subgroup of the micro-psi version of this table is not what one would expect had the two Theosophists been influenced by their knowledge of chemistry, which could not have provided any reason for spreading their assignments in this way. The notion of hallucinations is, anyway, untenable in this context because (as will be explained later) they could not have generated a linear relationship between the numbers of fundamental constituents of MPAs and the *mass numbers* of *their corresponding atomic nuclei*—information which scientists began to acquire only in the 1930s, more than twenty years after the MPAs of most elements had been published.

Hydrogen, helium, nitrogen, and oxygen did not fit the micro-psi classification. The hydrogen MPA (Figure 2) was “seen to consist of six small bodies, contained in an egglike form. . . It rotated with great rapidity on its own axis, vibrating at the same time, the internal bodies performing similar gyrations. The whole atom spins and quivers and has to be steadied before exact observation is possible. The six little

Table 1. Micro-psi classification of the elements.

SPIKE GROUP	DUMB-BELL GROUP	TETRAHEDRON GROUP		CUBE GROUP		OCTAHEDRON GROUP		BARS GROUP	STAR GROUP
		A	B	A	B	A	B		
IA Lithium	IA Sodium	IIA Beryllium	IIA Magnesium	IIIB Boron	IIIB Aluminium	IVB Carbon	IVB Silicon	VIII Iron	0 Neon
VIIIB Fluorine	VIIIB Chlorine	VIB (Oxygen)	VIB Sulphur	VB (Nitrogen)	VB Phosphorus	IVB Titanium	IVB Germanium	VIII Cobalt	0 Argon
IA Potassium	IB Copper	IIA Calcium	IIB Zinc	IIIA Scandium	IIIB Gallium	IVA Zirconium	IVB Tin	VIII Nickel	0 Krypton
VIIA Manganese	VIIIB Bromine	VIA Chromium	VIB Selenium	VA Vanadium	VB Arsenic	Ln Cerium	Ln Terbium	VII Ruthenium	0 Xenon
IA Rubidium	IB Silver	IIA Strontium	IIB Cadmium	IIIA Yttrium	IIIB Indium	IVB Hafnium	IVB Lead	VIII Rhodium	“Kalon”
VIIA Technetium (“Masurium”)	VIIIB Iodine	VIA Molybdenum	VIB Tellurium	VA Niobium	VB Antimony	IVA Thorium		VIII Palladium	0 Radon
IA Caesium	Ln Samarium	IIA Barium	Ln Europium	IIIA Lanthanum	Ln Gadolinium			Elements “X” “Y” and “Z”	
Ln Promethium (“Illinium”)	Ln Erbium	Ln Neodymium	Ln Holmium	Ln Praseodymium	Ln Dysprosium			VIII Osmium	
Ln Thulium	IB Gold	Ln Ytterbium	IIB Mercury	Ln Lutecium	IIB Thallium			VIII Iridium	
VIIA Rhenium	VIIIB Astatine (“85”)	VIA Tungsten	VIB Polonium	VA Tantalum	VB Bismuth			VIII Platinum	
IA Francium (“87”)		IIA Radium		IIIA Actinium					
		VIA Uranium		V Protactinium					

bodies are arranged in two sets of three, forming two triangles that are not interchangeable" (Besant and Leadbeater, 1951).

Each body (called a "hydrogen triplet") contained three "points of light," arranged in a triangle in four of the bodies and in a straight line in the two others. Higher magnification revealed these points to be three-dimensional, particle-like images (Figure 3). As they were the basic constituents of all MPAs, Besant and Leadbeater called them "ultimate physical atoms" (UPAs). The UPA consists of ten separate, non-touching, closed curves, or "whorls," three of which (major whorls) appear brighter and thicker than the other seven minor whorls. The whorls spiral side by side two and a half times around a roughly spherical surface, the major and minor ones separating at the lower end of the UPA and spiralling upwards towards its broader end while revolving two and a half times around its central axis, both strands crossing over each other like the double-helix of the DNA molecule. Each whorl thus makes five revolutions, the ten whorls of the UPA twisting around its axis fifty times. The heart-shaped particle pulsates and spins rapidly about its axis, which also precesses in a spinning top motion. Besant and Leadbeater noticed two chiral forms of the UPA, one the mirror image of the other, a "positive" variety in which all its whorls spiral clockwise (looking down from the wider end) and a "negative" type with its whorls spiraling anticlockwise.

MPAs comprise different types of particles, each a cluster of UPAs. In general the same number of UPAs making up a similar set of particles are present within, say, each of the four funnels of an MPA belonging to the Tetrahedron Group or each of the six arms of an MPA in the Star Group. Although many varieties of particles are usually present in an MPA, these appear in other MPAs as well. These two traits of MPAs simplified Besant's and Leadbeater's task of finding how many UPAs an MPA contained because it meant that they did not have to count every one. Instead, they had merely to count how many different particles with known numbers of UPAs were in, say a funnel of the MPA, calculate the number of its UPAs, and then multiply this by the number of funnels. On comparing the UPA populations of MPAs, they found that these numbers were proportional approximately to the chemical atomic weights of their corresponding elements. For example, noting that the hydrogen MPA

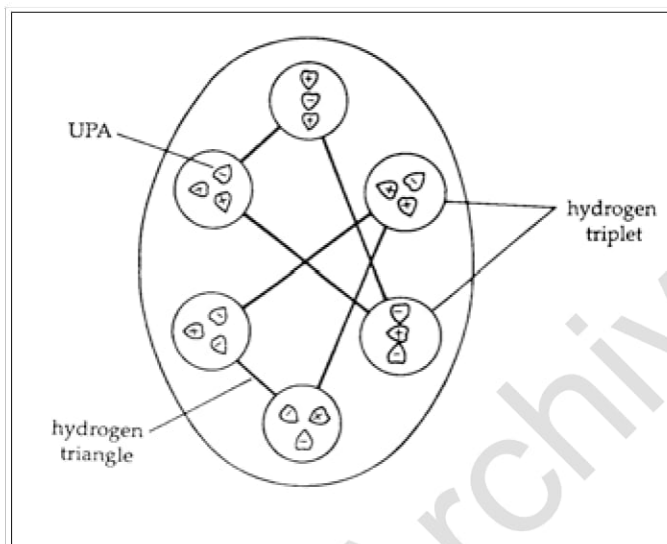


Figure 2. The hydrogen MPA.

contains 18 UPAs, the MPA of helium (with an atomic weight of 4) has 72 UPAs, four times that for hydrogen, the MPA of carbon (with an atomic weight of 12) has 216 UPAs, twelve times that for hydrogen, and the MPA of oxygen (with an atomic weight of 16) has 290 UPAs, almost sixteen times that of hydrogen. Thirty-nine of the 111 MPAs that were recorded were found to have populations that were *exactly* integer multiples of 18. This relationship between UPA populations and atomic weights was accurate enough to enable Besant and Leadbeater to check or ascertain the identity of the element corresponding to an MPA by comparing its "number weight," defined as

$$\text{number weight} = \text{UPA population}/18,$$

with scientific tables of atomic weights and by picking out the element whose atomic weight best agreed with this calculated figure. The fact that the agreement is only *approximate* is very significant because it is evidence that Besant and Leadbeater did not invent this rule of proportionality in order to concoct an impressive correlation with chemistry. The population data published for the fifty-seven elements both known to science and examined by Besant and Leadbeater up to 1908 do not support the hypothesis of fraud because, if one assumes that they made up the formula $N = 18X$ to fabricate populations (N) with the aid of a certain list of atomic weights (X) given in the first edition of their book *Occult Chemistry*, one finds that the best fit is

$$N = (18.055 \pm 0.014)X.$$

Their data, therefore, are fitted very poorly by the formula $N = 18X$ and the hypothesis that they were fabricated must be rejected because it is highly unlikely ($p < 10^{-4}$).

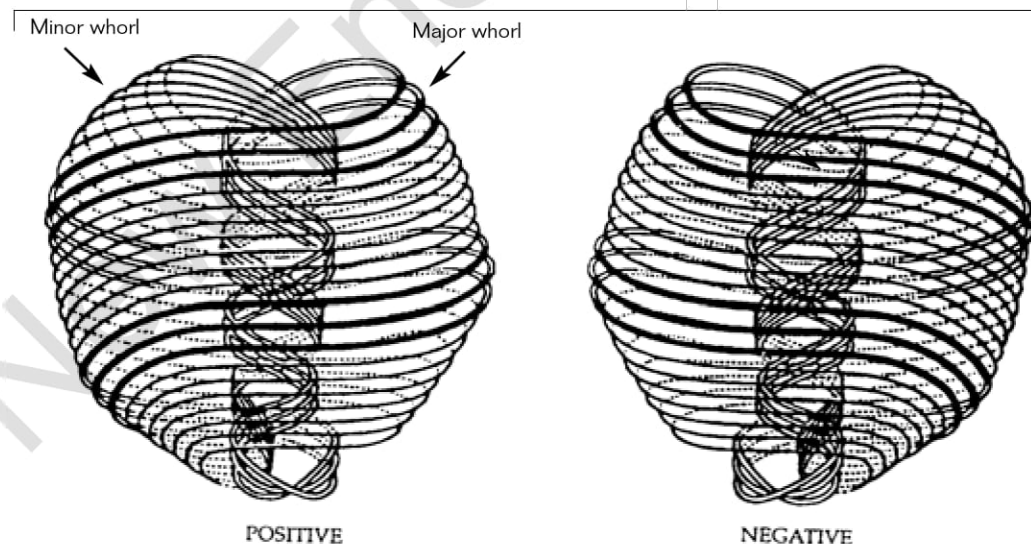


Figure 3. The two types of UPA are mirror images of each other.

Problems with Science

Besant and Leadbeater established two correlations between their micro-psi observations and chemistry, namely, that MPAs in the same group of the chemists' periodic table have the *same* shape, and that the number of UPAs belonging to an MPA is approximately proportional to the atomic weight of its corresponding element, the proportionality constant, 18, being the same for every element. But these were about the only discoveries they made which did *not* seem to conflict with science. Some of the most serious discrepancies are:

1) Although, when chemical compounds were examined, different MPAs combined into larger units in the same numbers as the corresponding atoms are known to do in their molecules, MPAs were often *broken up* and their constituents mixed with those of other MPAs—in total disagreement with what is known in chemistry. Leadbeater realized that such observations conflicted with atomic theory when he studied chemical compounds with his micro-psi faculty in the mid-1920s. But this did not stop him from claiming that MPAs were atoms. Such persistence is not the expected behavior of a psychic fraudster, who would have made sure his observations agreed with what was scientifically known at the time.

2) MPAs do not resemble the Rutherford-Bohr model of the atom. While Besant and Leadbeater might be forgiven for not noticing the much smaller atomic electrons—either as discrete particles or as waves—if their micro-psi vision automatically focused upon atomic nuclei, the large variety of particles they reported inside MPAs is inconsistent with the fact established in 1932 that atomic nuclei are aggregates of just two types of particles, namely protons and neutrons.

3) When Leadbeater described (Leadbeater, 1951) the molecule of benzene as octahedral in shape, chemists already knew that it is flat and hexagonal. He depicted the molecule of methane as octahedral, whereas it is tetrahedral. Worse still, instead of seeing three whole MPAs of oxygen in the ozone molecule, Leadbeater reported that the unit of ozone consists of three objects, each of which is one of the two dissimilar halves of an MPA of oxygen—that is, one and a half MPAs in total!

4) Situated in the micro-psi periodic table between the two sets of transition elements ruthenium, rhodium, and palladium and osmium, iridium, and platinum and belonging—like these elements—to the bars group are elements which Besant and Leadbeater called “X,” “Y,” and “Z,” while lying between xenon and radon is another inert gas belonging to the star group, which they called “kalon,” describing it in 1907 as being very rare compared with the other inert gases. These four MPAs have number weights of 147.00, 148.55, 150.11, and 169.67, which differ too much from the mass numbers of isotopes of their neighbors in the bars group for it to be possible to identify them as such. But the scientific periodic table has no room for three unknown transition elements and another inert gas; according to atomic theory, the elements X, Y, Z, and kalon, which Besant and Leadbeater thought would be eventually discovered by science, simply cannot exist!

Such problems amount to overwhelming, irrefutable arguments against the two Theosophists' interpretation of MPAs as atoms. No amount of special pleading or implausible, *ad hoc* models of the modus operandi of micro-psi can resolve the conflict between established scientific facts and their wrong *assumption* that their micro-psi faculty enabled them to observe atoms in an undisturbed state. Micro-psi is an inter-

active form of observation of particles requiring, according to Besant and Leadbeater, the exercise of a “special form of will-power” (psychokinesis) to slow down the motions of particles sufficiently for their micro-psi images to become discernible. Such retardation would, inevitably, drastically alter the quantum state of what was selected for observation. So are MPAs, perhaps, atomic nuclei excited into higher states by the act of observing their constituents with micro-psi? Could the hydrogen MPA be one of the baryons that belong to either the two SU(3) octets of spin- 1/2 baryons or the SU(3) decuplet of spin-3/2 baryons, being formed from one of the two protons in a hydrogen molecule that came under observation when the gas was examined? No, because these baryons have lifetimes of the order of 10^{-10} seconds, whereas Besant and Leadbeater reported the hydrogen MPA to be stable. Furthermore, why should they miss observing the other proton in a hydrogen molecule that is of the same order of size as molecules of compounds they *did describe*? They stated categorically (Besant and Leadbeater, 1951) that “hydrogen atoms were not observed to move in pairs.” Admittedly, a sufficiently energetic process accompanying micro-psi observation might have dissociated the hydrogen molecule, leaving only one proton to be focused upon. But why did this not happen when Leadbeater examined water, the molecule of which he described correctly as composed of two hydrogen MPAs and one oxygen MPA?

Such problems render untenable the idea that MPAs are highly excited states of atomic nuclei. But what else could the two Theosophists have seen? Firstly, if their visions were nothing more than *shared, complex* hallucinations that extended intermittently over a period of thirty-eight years (an implausible scenario in itself), why should the form of an MPA have correlated with the position of the element in the periodic table if it were *not* an atom? Arguments given earlier refute the skeptic's answer that the correlation was fabricated or due to hallucinations being influenced by a knowledge of chemistry. Secondly, how could hallucinations, whose cause was located entirely inside their brains and not outside among the trillions of atoms in all the chemicals they examined, generate UPA populations in MPAs that always turned out to be about 18 times the atomic weights of their elements? This is true, remarkably, even for elements like francium and astatine, whose exact atomic weights must have been unknown to Besant and Leadbeater because science discovered them in, respectively, 1939 and 1940, about seven years after the deaths of the two Theosophists. How, if MPAs are only hallucinations, could they have anticipated in 1908—five years before scientists suspected the existence of isotopes—the fact that an element such as neon could have more than one type of atom—an MPA, moreover, whose calculated number weight of 22.33 is consistent with their having detected the neon-22 nuclide paranormally before the physicist J.J. Thomson “officially” discovered it in 1913? One must turn to particle physics for answers.

Quark Model

It is now known that strongly interacting subatomic particles are composed of six types of spin-1/2 particles called “quarks.” They are the up (u), down (d), charm (c), strange (s), top (t), and bottom (b) quarks. The lightest quark is the up quark. Together with its partner, the down quark, it makes up the protons and neutrons inside atomic nuclei. A

proton consists of two positively charged up quarks and a negatively charged down quark and a neutron consists of one up quark and two down quarks. Because the standard model provides no reason why only six varieties of quarks exist, some physicists, including the author (Phillips, 1979), have proposed that quarks are not fundamental but are composed of still smaller, indivisible particles. Although called "preons" or "prequarks" by physicists, these as yet hypothetical entities will be referred to here as "subquarks," a term which does not have the possibly false implication that leptons are also composed of preons, as theories of preons usually require (see Harari, 1984).

If quarks consist of three subquarks, protons and neutrons would each comprise nine subquarks (Figure 4). Compare this picture with Figure 2, which shows how Leadbeater portrayed the hydrogen MPA in 1932. An egg-shaped ovoid contains two overlapping triangular arrays ("hydrogen triangles") of three spheres ("hydrogen triplets"), each enclosing a group of three UPAs.¹ Besant and Leadbeater distinguished between "positive" and "negative" groups of UPAs. Although they never explained what they meant by these terms,² they indicated this difference diagrammatically by depicting positive groups of UPAs such as hydrogen triplets with their heart-shaped UPAs pointing outwards from the geometrical center of the bound state, while negative triplets were depicted with their UPAs pointing inwards towards the center. The lower hydrogen triangle in Figure 2 contains two positive triplets and one negative triplet. Compare this with the fact that a proton contains two positively charged u quarks and one negatively charged d quark. Hydrogen has a diatomic molecule consisting of two protons bound together by their electrostatic attraction to two shared electrons. Suppose, therefore, that the lower hydrogen triangle is a proton originating from a hydrogen molecule that came under Leadbeater's observation. Then, according to quark theory, each positive triplet would be a positively charged u quark and the negative triplet would be a negatively charged d quark, *implying that the UPA is a subquark*. The upper hydrogen triangle contains a positive triplet (u quark), a linear triplet of UPAs that is negative (d quark) because its outer UPAs point inwards, and a linear triplet whose polarity (and therefore quark type) cannot be inferred because for some unknown reason the diagrammatic convention for depicting triplets was not followed for this triplet.³ This means that the upper hydrogen triangle could be either a proton or a neutron. According to Besant and Leadbeater, the hydrogen

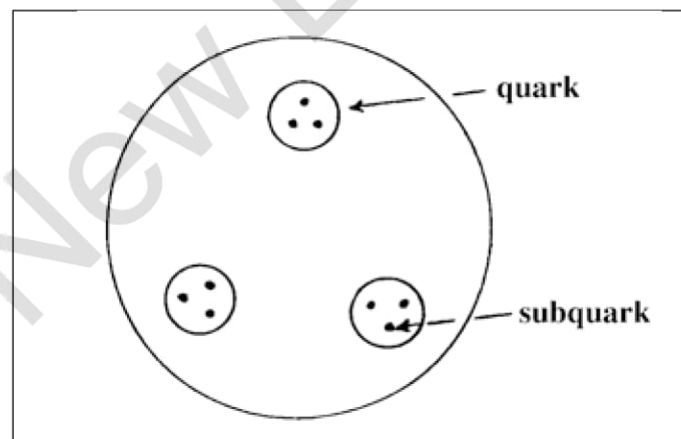
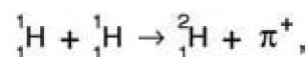


Figure 4. Subquark model of the proton and neutron.

MPA was stable. This rules out the proton because the diproton is known to be unstable. But it could be a neutron if the intervention of the micro-psi observer induced for some reason an inelastic collision between the two protons in the original hydrogen molecule. This changed one of them into a neutron that became bound to the other, creating a deuteron, which is stable:



the pion flying away and thus escaping observation. In view of the process of formation of MPAs to be hypothesized shortly, this possibility is not as *ad hoc* as it may seem. An observation consistent with the hydrogen MPA being a deuteron is that "each of the three groups making one half of Hydrogen are linked to each other across space by lines of attraction." This could be simply the nuclear force binding the proton and neutron together in a deuteron.

Leadbeater could not have observed the deuteron in one end of a diatomic HD or D₂ molecule because their rarity compared with H₂ molecules means that he would usually have seen just one hydrogen triangle whenever he examined hydrogen, and so he would have reported the version of the MPA consisting of *pairs* of hydrogen triangles as rare, just as he did sometimes when examining isotopic variations of other elements. Similarly, the hydrogen MPA cannot depict one end of an H₂ molecule because Leadbeater would then have observed only one hydrogen triangle/proton. Nor can it depict a whole hydrogen molecule because the two hydrogen triangles were seen to intersect each other, as Figure 2 indicates, whereas the distance between the two protons in a hydrogen molecule is of the order of magnitude of 10⁻⁸ cm—about 100,000 times the experimentally measured rms radius, 0.8 x 10⁻¹³ cm, of the proton's charge distribution.

A Statistical Test

The conclusion, therefore, seems inescapable that the micro-psi powers of Besant and Leadbeater allowed them to observe not (as they supposed) single hydrogen atoms but a deuteron formed by the collision of pairs of their nuclei. Suppose this was true for all the MPAs they observed, *i.e.* the MPA of every element is formed from *two* atomic nuclei of the element. This generalization makes the following testable prediction: if quarks contain three subquarks, then protons and neutrons, which consist of three quarks, must each contain nine subquarks. The number of protons and neutrons in a nucleus is its mass number A. So the number of subquarks in a nucleus is 9A. The identification of UPAs as subquarks implies that the number of UPAs in an MPA formed from two similar nuclei of a nuclide of mass number A is

$$N(A) = 18A.$$

The number weight is therefore predicted to be

$$N(A)/18 = A.$$

This explains why Besant and Leadbeater found their calculated number weight for an element to be approximately equal to its atomic weight, for most elements have stable nuclides with mass numbers within one or two units range of their atomic weight. In fact, as many as 39 of the 111 MPAs recorded by Besant and Leadbeater have populations

of UPAs that are exactly 18 times the mass numbers of (usually) the most abundant nuclide of their corresponding element. The first edition of their book *Occult Chemistry* lists atomic weights which were published in the so-called "International List" of 1905 and appeared in a scientific handbook the two Theosophists referred to throughout their collaboration. Except for hydrogen, none of these atomic weights is an integer, let alone one that is a multiple of 18. This means that they had no reason to make population numbers multiples of 18. Yet such multiples exist in a sig-

nificant fraction (33%) of all the MPAs. If, intent on fraud, they had decided for some reason that the hydrogen MPA should have 18 UPAs and—in order to procure best agreement between atomic weights and their number weights—had concocted population sizes by choosing integers nearest to the fractional value of the product of 18 and the atomic weight, it is highly improbable that such a large proportion would have turned out by chance to be integer multiples of 18. Indeed, as was pointed out earlier, choosing 18 as the proportionality constant in a relationship of proportionality

Table 2. Counted UPA N and predicted subquark N(A) populations of 95 MPAs.

Nuclide					Error					Nuclide					Error				
Element		N	N(A)	e	Element		N	N(A)	e	Element		N	N(A)	e	Element		N	N(A)	e
Hydrogen	¹ H	18	18	0	Cadmium	¹¹² Cd	2,016	2,016	0										
Deuterium	² H	36	36	0	Tin	¹¹⁸ Sn	2,124	2,124	0										
(Adyarium)																			
Helium	³ He	54	54	0	Antimony	¹²¹ Sb	2,169	2,178	-9										
(Occultum)	⁴ He	72	72	0	Iodine	¹²⁷ I	2,287	2,286	+1										
Lithium	⁷ Li	127	126	+1	Xenon	¹²⁹ Xe	2,298	2,322	-24										
Beryllium	⁹ Be	164	162	+2	Xenon (meta)	¹³⁰ Xe	2,340	2,340	0										
Boron	¹¹ B	200	198	+2	Caesium	¹³³ Cs	2,376	2,394	-18										
Carbon	¹² C	216	216	0	Barium	¹³⁶ Ba	2,455	2,448	+7										
Oxygen	¹⁶ O	290	288	+2	Lanthanum	¹³⁹ La	2,482	2,502	-20										
	¹⁷ O	310	306	+4	Cerium	¹⁴⁰ Ce	2,511	2,520	-9										
Fluorine	¹⁹ F	340	342	-2	Praseodymium	¹⁴¹ Pr	2,527	2,538	-11										
Neon	²⁰ Ne	360	360	0	Neodymium	¹⁴³ Nd	2,575	2,574	+1										
Neon (meta)*	²² Ne	402	396	+6	Promethium	¹⁴⁷ Pm	2,640	2,646	-6										
Sodium	²³ Na	418	414	+4	Promethium (meta)	¹⁵¹ Pm	2,736	2,718	+18										
Magnesium	²⁴ Mg	432	432	0	Samarium	¹⁵⁴ Sm	2,794	2,772	+22										
Aluminum	²⁷ Al	486	486	0	Europium	¹⁵³ Eu	2,843	2,754	+89										
Silicon	²⁸ Si	520	504	+16	Gadolinium	¹⁶⁰ Gd	2,880	2,880	0										
Phosphorus	³¹ P	558	558	0	Terbium	¹⁵⁹ Tb	2,916	2,862	+54										
Sulphur	³² S	576	576	0	Dysprosium	¹⁶⁴ Dy	2,979	2,952	+27										
Chlorine	³⁵ Cl	639	630	+9	Holmium	¹⁶⁵ Ho	3,004	2,970	+34										
	³⁷ Cl	667	666	+1	Erbium	¹⁶⁸ Er	3,029	3,024	+5										
Argon	⁴⁰ Ar	714	720	-6	Thulium	¹⁶⁹ Tm	3,096	3,042	+54										
Postassium	³⁹ K	701	702	-1	Ytterbium	¹⁷⁴ Yb	3,131	3,132	-1										
Calcium	⁴⁰ Ca	720	720	0	Lutecium	¹⁷⁵ Lu	3,171	3,150	+21										
Scandium	⁴⁵ Sc	792	810	-18	Hafnium	¹⁷⁸ Hf	3,211	3,204	+7										
Titanium	⁴⁸ Ti	864	864	0	Tantalum	¹⁸¹ Ta	3,279	3,258	+21										
Vanadium	⁵¹ V	918	918	0	Tungsten	¹⁸³ W	3,299	3,294	+5										
Chromium	⁵² Cr	936	936	0	Rhenium	¹⁸⁷ Re	3,368	3,366	+2										
Manganese	⁵⁵ Mn	992	990	+2	Iridium	¹⁹³ Ir	3,458	3,474	-16										
Iron	⁵⁶ Fe	1,008	1,008	0	Platinum (A)	¹⁹⁴ Pt	3,486	3,492	-6										
Cobalt	⁵⁹ Co	1,036	1,062	-26	Platinum (B)	¹⁹⁶ Pt	3,514	3,528	-14										
Nickel	⁶⁰ Ni	1,064	1,080	-16	Gold	¹⁹⁷ Au	3,546	3,546	0										
Copper	⁶³ Cu	1,139	1,134	+5	Mercury (A)	¹⁹⁹ Hg	3,576	3,582	-6										
Germanium	⁷² Ge	1,300	1,296	+4	Mercury (B)	²⁰⁰ Hg	3,600	3,600	0										
Arsenic	⁷⁵ As	1,350	1,350	0	Thallium	²⁰⁵ Tl	3,678	3,690	-12										
Bromine	⁷⁹ Br	1,439	1,422	+17	Lead	²⁰⁷ Pb	3,727	3,726	+1										
Krypton	⁸² Kr	1,464	1,476	-12	Bismuth	²⁰⁹ Bi	3,753	3,762	-9										
Krypton (meta)	⁸⁴ Kr	1,506	1,512	-6	Polonium	²¹⁰ Po	3,789	3,780	+9										
Rubidium	⁸⁵ Rb	1,530	1,530	0	Astatine ('85')	²¹⁰ At	3,978	3,942	+36										
Strontium	⁸⁸ Sr	1,568	1,584	-16	Emanation	²²² Em	3,990	3,996	-6										
Yttrium	⁸⁹ Y	1,606	1,602	+4	Emanation (meta)	²²⁰ Em	4,032	3,960	+72										
Zirconium	⁹⁰ Zr	1,624	1,620	+4	Francium ('87')	²²³ Fr	4,006	4,014	-8										
Niobium	⁹³ Nb	1,719	1,674	+45	Radium	²²⁶ Ra	4,087	4,068	+19										
Molybdenum	⁹⁷ Mo	1,746	1,746	0	Actinium	²²⁸ Ac	4,140	4,104	+36										
Technetium	⁹⁹ Tc	1,802	1,782	+20	Thorium	²³² Th	4,187	4,176	+11										
Ruthenium	¹⁰² Ru	1,848	1,836	+12	Protactinium ('91')	²³⁴ Pa	4,227	+15											
Rhodium	¹⁰³ Rh	1,876	1,854	+22	Uranium	²³⁸ U	4,267	4,284	-17										
Palladium	¹⁰⁶ Pd	1,904	1,908	-4															

* 'meta' denotes an isotopic variation.

between population size N and atomic weight X gives a very poor fit to the data, there being less than one chance in ten thousand that the data could have been fabricated in this way.

Even supposing that Besant and Leadbeater knew of Prout's hypothesis (formulated at the beginning of the last century and [by then] long discredited by the discovery of fractional atomic weights) that atoms are made up of hydrogen atoms and that they devised UPA populations that were often multiples of 18 in order to support this idea, it would have been far easier, as well as more consistent, to concoct MPAs made up of pairs of hydrogen triangles—hydrogen MPAs—than to invent *dozens* of types of constituents of MPAs in such numbers as to make the total UPA population a multiple of 18 in one-third of them. Only one other (helium) of the 111 recorded MPAs contains a hydrogen MPA. Moreover, why, if intent on fabricating observations to agree with science, would the two Theosophists have made up data supporting an idea which any contemporary chemistry textbook would have told them chemists no longer believed? The fact that the population data are very poorly fitted by the equation above (much less accurately than the prediction $N = 18A$; see below) discounts the possibility that the linear relationship between population size and atomic weight was made up. Indeed, the very absence of hydrogen MPAs and, instead, the presence of so many different *types* of particles, is incontrovertible evidence that MPAs are *not* even atoms or nuclei, let alone fabricated representations of atoms.

The difference

$$e = N - N(A)$$

between the UPA population N and the predicted number $N(A)$ of UPAs must represent either the gross discrepancy due to one or more random errors of observation or—as more often turns out to be the case—the net error due to undercounting of UPAs in some components of an MPA and overcounting in others. Table 2 shows that discrepancies between counted and predicted populations are very small (usually less than 1%) compared with the former.⁴ Three criteria determine the choice of nuclide that most probably formed a given MPA:

- (1) *Abundance*: The nuclide most likely to have formed the MPA is that which, among all the nuclides of the element, has the greatest terrestrial abundance;
- (2) *Stability*: Unless the element is naturally radioactive, the nuclide must be stable;
- (3) *Plausibility of observational error*: The magnitude of e should be compatible with the geometrical symmetry of the MPA. This is because, as explained earlier, Besant and Leadbeater did not count every UPA in an MPA but, instead, calculated the number in a component of the MPA, using previously established count numbers for individual groups of UPAs, and then multiplied this number by the number of identical components, thereby amplifying any actual miscounting of UPAs. For example, a nuclide is not a plausible candidate if it predicts an error $e = 3$ for an MPA consisting of four identical parts. Figure 5 demonstrates that the population data of Table 2 are best fitted in a graph by the straight line

$$N = (0.48 \pm 3.99) + (18.03 \pm 0.03)A,$$

which confirms the theoretical prediction $N = 18A$ at the 5% confidence level.

In the case of elements having only one stable nuclide there is no uncertainty as to which nuclide formed the

MPA. A sample of twenty-three such elements with single nuclides⁵ provides the best fit

$$N = (18.042 \pm 0.044)A,$$

which differs from the model prediction by less than one standard deviation. The population data for MPAs of elements having only one stable isotope strongly supports the hypothesis that MPAs are formed from two atomic nuclei of the corresponding element.

It is only to be expected that errors crept into the micro-psi observations because many MPAs contain several thousand UPAs. It testifies to Besant's and Leadbeater's accuracy that their predicted observational errors are so relatively minute. Indeed, errors of counting UPAs in individual particles must have been even smaller because the method of determining UPA populations (mostly Leadbeater's task) inflated the effect of any miscounting. Moreover, if an error had been made in the counting of UPA comprising a particle the first time it was observed, this mistake would have been perpetuated for *all* elements later examined whose MPAs contained this particle, leading to discrepancies between counted and predicted populations which could be larger than the actual random errors made for the given MPA. Analysis of 51 MPAs reveals (Phillips, 1995) several examples of this compounding of errors which, when corrected for by taking into account the predicted miscounting of UPAs in some of their particles, turn out always to have UPA populations agreeing exactly with prediction. By not recounting the UPAs in every particle in a newly found

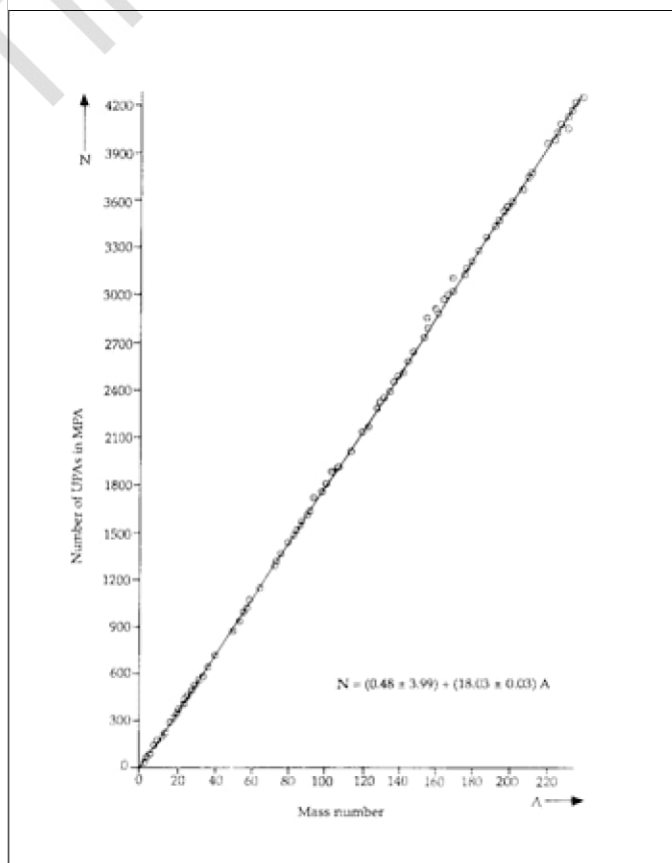


Figure 5. The proportionality between the numbers of UPAs in MPAs and the numbers of protons and neutrons in nuclei of their corresponding isotopes is evidence of the objective nature of the micro-psi observations made by Besant and Leadbeater.

MPA, Besant and Leadbeater introduced a source of systematic error into their work, although this methodological weakness is forgivable in view of the Herculean task they would have faced in counting every one of the possibly thousands of UPAs in an MPA.

Qualitative Tests

The hypothesis that an MPA consists of the subquarks present in two (usually) similar atomic nuclei of an element has been tested qualitatively as well as quantitatively (Phillips, 1980) by analyzing 23 of the 26 MPAs Besant and Leadbeater described for the first twenty elements of the periodic table, including several of their isotopes. For the sake of convenience of discussion, a particular subquark model (Phillips, 1979) was employed. But the only property of this model that was *effectively* used and successfully tested is its prediction of the subquark composition of u and d quarks:

$$u = (X, X, Y), \quad d = (X, Y, Y),$$

where X is a subquark which is positively charged (+5/9, in the author's model) and Y is a subquark with negative electric charge (-4/9, according to this model). Using only this model-dependent prediction,⁶ a remarkably high level of agreement was found between elementary facts of nuclear physics, the quark model, and nearly every one of the thousands of details in this sample of MPAs. Not only did the UPA populations agree exactly with prediction in over 50% of the cases, discrepancies being plausibly explainable in terms of small, observational errors, but also—even more significant—the types of particles, their reported “positivity” or “negativity,” and even the numbers of each type were found to be consistent with the hypothesis that an MPA is formed from two atomic nuclei of an element. This extremely detailed confirmation was made possible because nearly half of the 111 MPAs published in the third edition of Besant's and Leadbeater's book *Occult Chemistry* have diagrams depicting *every* particle observed in these MPAs, as well as the triplets and pairs of UPAs composing them. Their convention of representing in these diagrams “positive” and “negative” groups of UPAs proved invaluable because it enabled consistency between theory and observation to be demonstrated at the subquark level as well as the quark level. Indeed, these diagrams eliminated completely all freedom to interpret the subquark composition of particles in MPAs because, once positive and negative hydrogen triplets are interpreted as, respectively, up and down quarks, the latter's subquark composition given above can in fact be *inferred* (Phillips, 1995), and this determines the subquark composition of every particle because the diagrams displaying all their constituent triplets and pairs of UPAs indicate whether they are positive or negative groups. This makes the analysis of MPAs *entirely* deductive—all that needs to be assumed is that MPAs are formed from two nuclei.

Twenty-eight more MPAs were later analyzed (Phillips, 1995) in a similar, self-consistent manner. These are the remaining MPAs with diagrams allowing detailed correlations between theory and observation to be made. These pose a more stringent test of the author's hypothesis that two atomic nuclei form a MPA than the 23 MPAs previously analyzed because they contain far more varieties of particles, all of which must be identified in a way that is not only compatible with the hypothesis itself but also consistent with previously established identities for these particles, as well as

with the X and Y subquark compositions indicated by diagrams of their constituents. Despite these severe restrictions, perfect agreement was discovered between the subquark composition of particles implied by these diagrams and that found for other MPAs with these particles. This remarkably high degree of consistency cannot be accidental because of the vast number of matchings necessitated by a sample of 51 MPAs, many of which contained thousands of UPAs. For example, the MPA of gold, which contains 3,546 UPAs, is the most populous of the MPAs of the elements having diagrams showing their constituents. Yet every detail of its diagrams can be self-consistently accounted for, demonstrating that this MPA agrees exactly with the hypothesis that it was formed from two atomic nuclei of Au-197, the only stable nuclide of this element. If the hypothesis had been wrong and/or if some of the particles in the gold MPA appearing also in the 23 MPAs analyzed earlier had been physically misinterpreted, discrepancies would inevitably have arisen either between theory and observation or between the results of earlier and later analyses. The fact that none emerge other than what is plausibly attributable to occasional, small, random errors of observation permits only one conclusion, namely, that Besant and Leadbeater accurately described by ESP quasi-nuclear, bound systems of subatomic particles created from pairs of atomic nuclei as the physical consequence of the intervention of their micro-psi faculty.

When the two Theosophists focused their micro-psi vision on atoms of an element (whether in the pure state or in a chemical compound), it is proposed that they caused for some reason a pair of atomic nuclei of that element to undergo a change of state in which their constituent subquarks and quarks became free momentarily, the particles in each nucleus pooling together as a plasma analogous to the quark-gluon plasma, or “quagma,” that experiments at CERN are attempting to create through high energy collisions of heavy ions (Greiner and Stöcker, 1985). As this plasma cooled, new forms of quark matter crystallized and interacted strongly, forming a quasi-nuclear system of many types of *stable* constituents, bound together by strong and electromagnetic forces to create an MPA. Physicists have suggested that stable forms of quark matter containing strange quarks as well as up and down quarks may exist. Perhaps, therefore, strange quarks are formed by the interaction between the constituent quarks released from the two atomic nuclei, their presence stabilizing the multi-quark bound states in the resulting MPA. This would not be inconsistent with the author's conclusion that two types of subquarks make up MPAs because these types refer solely to their electric charges, not to what particle physicists call the “flavor state” of quarks.

Problems Solved

Such a picture means that the conflicts with science raised by the two Theosophists' interpretation of MPAs as atoms—such as those discussed earlier—cease to exist. Consider firstly the anomalous feature of their description of molecules of chemical compounds: the scattering over the whole “molecule” of parts of different MPAs. Suppose that, when molecules were examined with micro-psi, the transformations of their atomic nuclei into MPAs happened sequentially rather than simultaneously. Such transformations would not proceed in isolation. For solids and liquids,

atoms of one molecule lie close to atoms in other similar molecules. When the destabilizing intervention of the observer induced a change of state of (in turn) pairs of similar nuclei, the successive processes of formation of MPAs from pairs of atoms of neighboring molecules would have interfered with one another, with some parts of an MPA drawn to other already formed MPAs by forces that were stronger than those holding them together. Far from being a scientific absurdity, the feature of some MPAs being partially broken up when observed in a chemical compound is actually what might be expected if the formation of an MPA were disrupted by local forces due to nearby MPAs or atoms not under observation. Then consider the problem that MPAs bear no resemblance to the Bohr model of the atom: this becomes irrelevant if MPAs are not atoms. Thirdly, discrepancies between chemistry and Leadbeater's description of benzene, methane, and ozone disappear because, as quasi-nuclear systems, MPAs would interact through the nuclear force, which would create bound states of MPAs with quite different configurations to those of atoms bonded together in a molecule by electromagnetic forces. Finally, what about the four "impossible" elements X, Y, Z, and kalon, which have no place in the periodic table? If MPAs were formed from two nuclei, those that correspond to no known elements could only exist in principle if they had originated from nuclei of two *different* elements. (Indeed, no theory of MPAs that identifies them with single atoms or nuclei can explain these anomalous MPAs.) Their UPA populations support this suggestion, as the following examples demonstrate:

1) The MPA of non-existent element X in the bars group of transition elements contains 2,646 UPAs. This is precisely the number it would have if it had been formed from nuclei of the isotopes Ru-102 and Os-192 of, respectively, ruthenium and osmium—transition elements whose compounds might have been simultaneously present in impure samples examined by Besant and Leadbeater;

2) The MPA of the impossible inert gas kalon has 3,054 UPAs. It could have been formed from nuclei of the Xe-124 and Em-220 or Em-222 isotopes, which contain, respectively, 3,096 and 3,114 UPAs, implying quite plausibly that either seven or ten too many UPAs were observed when one of the six arms of this star-fish-shaped MPA was examined. But if MPAs could be formed from nuclei of two *different* elements, it raises the question of why such hybrids were rarely observed. Reasons can be speculated but will not be discussed here.

Quantum Chromodynamics

According to quantum chromodynamics (QCD)—the currently accepted theory of the strong force between quarks—each of the six types of quark exist in three quantum states called "color" red, blue, and green. Each color state is characterized by its "color charge"—a property which is a mathematical generalization of the concept of electric charge. Just as the latter is the source of the electromagnetic field transmitted by the spin-1 photon, so the color charge is the source of the strong force binding quarks together. This "color force" is transmitted by eight spin-1 particles called "gluons." Two quarks in different color states interact strongly by exchanging any one of these gluons, its emission from one quark and its absorption by the other resulting in their switching color states. According to QCD, baryons such as the proton and neutron consist of three quarks in differ-

ent color states, while mesons consist of a colored quark and an antiquark in the antimatter counterpart of the color state of its partner. QCD permits only such "colorless" bound states of quarks to exist.

The color force is thought to grow without limit with increasing separation between quarks, permanently confining them in baryons and mesons. At short distances it becomes so weak that the quarks move almost freely. At sufficiently high energies or at high enough densities due to compression, atomic nuclei are predicted by QCD (Satz, 1986) to undergo a phase transition in which quarks cease to be confined in nucleons but move and interact with one another by exchanging gluons over the entire volume of the nucleus. This quark-gluon plasma, or "quagm," which we referred to earlier, is believed to have existed 10^{-3} seconds after the Big Bang. Little is currently known how, when either the density or the temperature of the quagm falls below the critical value, its quarks would regroup into hadrons. It has been speculated (Greiner and Stöcker, 1985) that quark clusters other than the three-quark baryon states or quark-antiquark meson states known to particle physicists might condense out of the quagm. If UPAs are subquarks, MPAs must be such exotic forms of matter. Do MPAs, therefore, represent an excited phase of nuclear matter that is formed prior to micro-psi observation by the collision and fusion of two atomic nuclei? If so, what local, physical conditions accompanying micro-psi observation could stabilize multi-quark and multi-subquark bound states against decay into the three-quark bound states more familiar to physicists? The problem is to explain how many different types of particles can co-exist in MPAs. This issue is related to the fundamental problem of the physical nature of the interaction between the micro-psi observer and what he describes, about which little is yet known.

Rather than being formed by the high-energy collision of two nuclei, MPAs may result from their constituents becoming extremely delocalized, as the following quantum-mechanical argument suggests: Besant and Leadbeater claimed to have been able to exert some kind of braking force on the motions of particles by exercising "a special form of will-power." If such retardation due to micro-PK forces happened automatically while they focused their micro-psi vision on atoms, it would mean that they reduced not only the momenta of atoms and the momenta of the constituents of their nuclei as they prepared atoms for observation but also their range of values. What in effect they did would have been to reduce the uncertainty Δp in the momentum of each particle in a nucleus as this braking force brought every particle to rest, tending to create in each one a state of known (zero) momentum. In accordance with the Uncertainty Principle:

$$\Delta X \Delta P > \frac{1}{2} \hbar$$

this increased the uncertainty ΔX in its position, stretching its wave packet. If the braking force reduced its kinetic energy by a factor of 10^8 , ΔX would be amplified by a factor of 10^4 from the nuclear size scale of 10^{-12} cm to the atomic scale of 10^{-8} cm, *i.e.* each particle would become so delocalized that there would now be just as much chance of finding it near an adjacent atomic nucleus as there was in finding it in the much smaller space occupied by a nucleus prior to its coming under observation. If all particles in selected pairs of

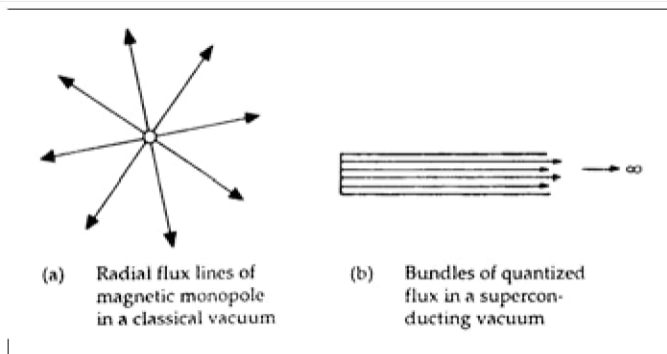


Figure 6. a) Radial flux lines of a magnetic monopole in a classical vacuum. b) Bundle of quantized flux in a superconducting vacuum.

nuclei were slowed down automatically prior to observation, their wave function would eventually overlap significantly, leading to a non-vanishing probability of their mutual strong interaction. The coupling of highly delocalized particles from neighboring nuclei and their aggregation into larger bound states would render uncertain their momenta, creating particles once again localized within a nuclear-sized domain and collectively bonded together by quasi-nuclear forces. Such a scenario, in which nuclei are no longer stable forms of matter under the physical conditions accompanying micro-psi observation, would explain why there is no trace of an intact, recognizable, atomic nucleus in any MPA, apart from a few exceptions such as the hydrogen MPA and the nitrogen MPA, which analysis indicates (Phillips, 1980, 1995) contains a cluster of seven neutrons originating from one of the two parent nitrogen nuclei.

String Model

The description of the force binding UPAs together provides further striking evidence for the objective character of these observations. Hundreds of diagrams published in *Occult Chemistry* depict groups of UPAs bound by string-like "lines of force." This feature supports the string model, a certain formulation of QCD. This model will be reviewed and

then compared with some of the numerous diagrams from *Occult Chemistry* which are consistent with it (for more examples, see Phillips, 1980).

In the Meissner effect, magnetic flux is almost completely expelled from the interior of a superconductor when a magnetic field is applied to it. This is caused by the wholesale formation at temperatures below a critical value of large numbers of loosely bound pairs of electrons ("Cooper pairs"), the motion of which in the external magnetic field produces locally a magnetic field which opposes and effectively cancels the applied field everywhere except near the surface of the material, resulting in little penetration of flux into its interior. In type 1 superconductors there is wholesale expulsion of magnetic flux; in type 2 superconductors the normally conducting regions of the material segregate into an array of filaments, arranged parallel to the external field and surrounded by the remaining superconducting material. These filaments are extended bundles of flux lines which have been expelled from the ambient, superconducting material through the Meissner effect and are trapped inside cylindrical vortices of circulating electrons of variable current density. The amount of flux in a vortex is quantized in integer multiples of the Dirac unit $hc/2e = 2 \times 10^{-7}$ gauss cm^2 . The core of the flux tube contains most of the flux, which extends with exponential decrease into the superconducting region a distance characterized by the "London penetration depth" $\lambda_L = (mc^2/4\pi ne^2)^{1/2}$, where m is the electron mass, e is its electric charge, and n is the density of superconducting electrons.

The Meissner effect may be interpreted in terms of photons inside superconductors acquiring mass and is an example of the so-called "Higgs mechanism" of spontaneous symmetry breaking, where massless gauge field—in this case the electromagnetic field—can acquire mass, resulting in a short-range interaction between the particle sources of these fields. Nielsen and Olesen pointed out in 1973 a remarkable parallelism between, on the one hand, the Higgs model and the London-Ginsberg theory of superconductivity and, on the other hand, the flux lines in type 2 superconductors and the dual string model of strong interactions, which had been developed to explain how

the scattering properties of hadrons interacting strongly with other hadrons varied with energy and with the momentum transferred between them. The string model of quark confinement exploits this analogy as follows: the vacuum is regarded as the ground state of the Higgs field, a type 2 superconductor in which quarks are embedded as monopole sources of the color force. The flux lines of an isolated, positively charged monopole in empty space diverge in all directions (Figure 6a). In the Higgs vacuum, however, they become squeezed together as quantized bundles within an infinitely long, narrow flux tube (Figure 6b), being expelled from the ambient, superconducting vacuum by the Meissner effect. An idealized magnetic monopole is the end-point of this flux tube, which is

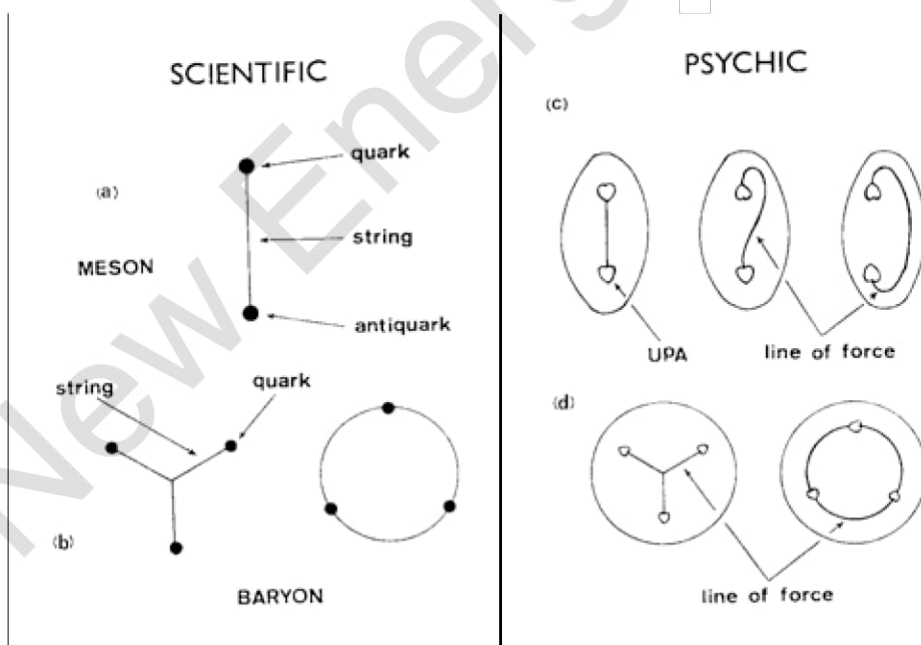


Figure 7.

a vortex in the Higgs field consisting of currents of Higgs bosons of variable density that circulate about the cortex core, into which most of the flux lines are squeezed. Flux lines emanate from the monopole if it is positively charged and converge on it if the monopole is negatively charged. As bound states of a quark and an antiquark, mesons are regarded in the string model as flux tubes, or "strings," of finite length (Figure 7a), one end of the string being the quark, the other being the antiquark. As bound states of three quarks, baryons are pictured by string theorists either as Y-shaped strings terminating on magnetic monopoles or as circular strings, two strings emanating from each monopole (Figure 7b). Both types of hadrons are surrounded by a cloud of virtual gluons extending a distance $A = h/m_0c$, where in m_0 is the mass of the gluon. According to the string model, quarks are permanently bound together because the string force increases with the length of the string.

Micro-Psi Confirmation of the String Model

Besant was responsible for reporting how groups of UPAs were bound together. In hundreds of diagrams published in *Occult Chemistry* she depicted UPAs bound of "lines of force," which were "magnetic" in character. Among these were diagrams showing *single* lines of force with a UPA at each end (Figure 7c), Y-shaped configurations of three lines of force, each terminating on a UPA, and circular configurations linking three UPAs (Figure 7d). Notice their resemblance to Figures 7a and 7b. This similarity makes it therefore natural to interpret the lines of force as strings or flux tubes. These duads and triplets of UPAs were recorded nearly seventy years before similar diagrams appeared (Tze and Ezawa, 1975) in the research literature of particle physics. These and many other diagrams in *Occult Chemistry* showing single lines of force terminating on UPAs in *exactly* the same way that the string model conceives color flux tubes terminating on quarks constitute remarkable evidence in support of the string model. They indicate that subquark UPAs possesses a magnetic charge, albeit of a kind similar to that associated with the color force rather than with ordinary magnetism. Indeed, the positive and negative types of UPAs have opposite magnetic polarity (Phillips, 1980). According to Besant

and Leadbeater, in the former "force comes out"; in the latter it "disappears." This is consistent with the elementary idea of north and south magnetic poles as sources and sinks of magnetic fields.

Duads, triplets, and other groups of UPAs were observed to be surrounded by either spherical or ovoid surfaces. When this "sphere-wall" was investigated, it appeared to be "composed of forces radiating from the center which after traveling a certain distance, returned to the center." It is proposed that these forces are simply the color flux due to the cloud of virtual gluons, which extends a distance A from the core of a flux tube into the ambient Higgs vacuum, the exchanged gluons propagating through flux tubes that pass through the centers of the bound states. The radial wave-function of three UPAs bound in a ground state of zero orbital angular momentum is spherically symmetric. The sphere-wall shown in Figure 7d is therefore the envelope of the color flux lines created by the spherical symmetry of the probability wave function of the three UPAs bound in an S state. The ovoid surface often reported to surround duads of UPAs (see Figure 7c) is the outer surface of the short-range gluon cloud of size A . Each UPA was also said to be "surrounded by a field." This could be the Higgs field whose quanta (Higgs bosons) circulate around the core of the flux tube emanating from the UPA monopole. Most groups of UPAs were shown linked by lines of force passing into the wide end and leaving the pointed end of the heart-shaped UPA (see Figure 3). Moreover, this force was "changed in character by its passage." This suggests that the UPA is the monopole source of two types of color flux, each squeezed into its own flux tube. It indicates that the color force needs to be generalized to a "hypercolor" gauge field, eight of whose quanta are the gluons mediating the strong interaction between subquarks belonging to *different* quarks, the remaining quanta being hypergluons that transmit the force confining subquarks *inside* the same quark.

Two important conclusions can be drawn from Besant's depiction of the lines of force linking UPAs in the hydrogen MPA: (1) three subquarks are bound together in *u* and *d* quarks by a Y-shaped string, *i.e.* subquarks are confined

Table 3. Some micro-psi anticipations of scientific discoveries and ideas.

MICRO-PSI		SCIENCE	
1895:	positive and negative hydrogen triplets observed in MPAs;	1964:	quark model proposes nuclei are made up of positive <i>u</i> quarks and negative <i>d</i> quarks;
1908:	meta-neon (number weight = 22.33); axes of UPAs observed to be aligned by electric field;	1912:	neon-22 discovered;
	UPAs depicted as joined by "lines of force" of "a magnetic nature;" some UPAs shown as endpoints of single lines of force;	1933:	magnetic monopoles with possible electric dipole moments discussed by Dirac;
	Y-shaped configurations of lines of force ending on UPAs published;	1970s:	string model of hadrons; quarks regarded as ends of strings of flux tubes;
1909:	'illinium' (number weight = 146.66); 'masurium' (number weight = 100.11);	1975:	baryons modelled as Y-shaped strings with quarks at their ends;
1924:	processional motion of "hydrogen triangles" (protons);	1945:	promethium-147 discovered;
1932:	'element 85' (number weight = 221.00); 'element 87' (number weight = 222.55)	1937:	technetium-99 discovered;
		1924:	spin of nuclei suggested;
		1940:	astatine-219 discovered;
		1939:	francium-223 discovered;

inside quarks by the *same* mechanism (Meissner effect) as that which confines quarks inside baryons; (2) one subquark in each quark in a proton is the end-point of a much larger, Y-shaped string, as is true for the two other subquarks. In other words, the three quarks are held together by three concentric, Y-shaped strings, three flux tubes emanating from each quark. For more details, see Phillips, 1980.

Conclusion

This article has presented evidence (summarized in Table 3) of how facts of nuclear and particle physics are consistent with purported psychic descriptions of subatomic particles. It is because Besant and Leadbeater finished their observations many years before pertinent scientific knowledge became available that their work cannot be dismissed as fraudulent. Nor can their observations be interpreted as precognitive visions of future ideas and discoveries of physics. If this had been the case, they might have been expected to describe atoms according to the Rutherford-Bohr model. The nuclear model of the atom was formulated by Rutherford in 1911, only two years after they concluded their main investigation of MPAs. Yet its basic features do not appear in their publications. Instead of being atoms or nuclei (what one would expect if their micro-psi faculty were actually precognition), MPAs are more exotic objects which, as Figure 5 and analysis of 51 MPAs prove (Phillips, 1995), have UPA populations and compositions indicating that they consist of the constituent quarks and subquarks of two atomic nuclei of an element. They represent a new phase of nuclear-matter, and are more akin to what nuclear physicists call "compound nuclei," which are briefly formed in high-energy physics laboratories by the collision and fusion of two very fast-moving, heavy ions. The fact that most of their descriptions of MPAs were published several years before physicists even suspected that atoms had nuclei concludes the possibility of their fraudulent use of scientific knowledge about the make-up of nuclei in terms of protons, neutrons, and mass numbers because no such information existed then, Chadwick discovering the neutron in 1932—twenty-four years after *Occult Chemistry* was first published. So there exists no viable normal or alternative, paranormal explanation of why their one hundred year old descriptions of subatomic particles should correlate with modern physics other than that Besant and Leadbeater genuinely used ESP to describe aspects of the microscopic world, albeit one radically disturbed by the act of paranormal observation. The discovery of the last quark one hundred years after they commenced their investigations makes it therefore timely to point out that, if the author's explanation of their work is right, this does not mark the end of the search for the basic forms of matter.

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Footnotes

1. This schematic diagram is not drawn to scale.
2. These terms cannot simply indicate whether bound states of UPAs consist of more positive UPAs than negative ones or more negative UPAs than positive ones because one of the (+) triplets in the lower hydrogen triangle of the hydrogen MPA has two positive UPAs and one negative UPA whereas the other (+) triplet has two negative UPAs and one positive UPA.
3. This triplet is depicted on page 43 of the first edition of *Occult Chemistry* not as a bound state of UPAs but as a set of *free* UPAs—an obvious error which Leadbeater did not correct when he re-examined in 1932 the hydrogen atoms in a water molecule and which reappeared in the third edition edited by his colleague, Jinarajadasa, without its recognition by the latter as an error.
4. Ninety-five of the 111 MPAs recorded in the third edition of *Occult Chemistry* are listed here. The rest are either MPAs to which no element can be assigned and which could *only* have been formed from nuclides of two *different* elements or MPAs formed from two different nuclides of the same element, for both of which the formula $N = 18A$ is inappropriate.
5. These are: beryllium, fluorine, sodium, aluminum, phosphorus, scandium, manganese, cobalt, arsenic, yttrium, niobium, rhodium, iodine, caesium, praseodymium, terbium, holmium, thulium, gold, bismuth, and thorium. The sample included hydrogen and helium because no uncertainty exists about which of their nuclides formed their MPAs.
6. This prediction of the author's model may remain valid despite the latter's wrong prediction of the number of quark generations and its incompatibility with superstring theory, which predicts a unified gauge symmetry group of lower rank.

About the Author

Dr. Phillips received a B.S. in theoretical physics from Cambridge University and an M.Sc. in high-energy physics from the University of Cape Town (South Africa) in 1971. He earned his Ph.D. at the University of California-Los Angeles, where he also taught mathematics and physics. He has published three books and his work has appeared in several academic journals, magazines, and newspapers.

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Encounter with a Cover-Up: Examining a Forbidden Report

*Proceedings of the EPRI-NSF Workshop
on Anomalous Effects in Deuterated Metals*
October 16-18, 1989—Washington, D.C.

by Eugene F. Mallove

For years I had been hearing about these now seemingly ancient proceedings of a restricted access cold fusion meeting that was held in October 1989, but I was not sure a finished document had been compiled. I certainly knew that the meeting had occurred (see pp. 181-185 of *Fire from Ice*),¹ but that a detailed report had finally issued had been kept very quiet. That's how secret the existence of this massive report had been. Even this "cold fusion ferret" did not see it until late 2000.

It transpires that the EPRI-NSF joint meeting *Proceedings* were finally printed years later, in 1993, which may qualify as a world record for delayed proceedings. EPRI (Electric Power Research Institute) is the private research arm of many electric utility companies within the U.S. and NSF is the National Science Foundation, a science funding agency within the Federal government. These *Proceedings* are an astonishing, secret account of a private but *publicly funded* meeting that bears on a topic of overarching importance in the cold fusion saga: *who knew what and when did they know it*. Consisting of formal scientific papers, plus transcriptions of scientific dialogue following each of the thirty presentations, the report is of much greater significance than I had imagined before reading it. The meeting occurred in Washington, less than two weeks before the DOE ERAB Cold Fusion Panel was to cast its final negative vote against cold fusion on Halloween, October 31, 1989. The public would not see the evidence for cold fusion laid out with such clarity until much later, until the First Annual Conference on Cold Fusion in Salt Lake City, in late March 1990. By then, of course, the chorus of cold fusion critics had long since succeeded in poisoning the public mind with press manipulation and *ad hominem* attacks against cold fusion researchers.

Prominently stamped in two places at the beginning of the EPRI-NSF *Proceedings* is the stern admonition: "Note: This document has been prepared for workshop attendees and is not intended for wide distribution." Mind-boggling! We have been lectured for years that secrecy in protecting commercial interests was one of the main problems with cold fusion research, and here some of the enemies of cold fusion are seen trying to classify it retrospectively! What were they trying to hide?

The "Editorial Perspective," which introduces the *Proceedings*, was written by one Thomas R. Schneider, a miscreant within EPRI who was known to be bent on disproving cold fusion to the world—more remarkable, because he is in complete opposition to the thrust of the EPRI-sponsored work at SRI International and elsewhere, which confirmed the work of Fleischmann and Pons.² Schneider wrote, "This workshop, held October 16-18, 1989, was the first forum

that succeeded in achieving a frank and open scientific discussion on the controversial findings reported by Pons and Fleischmann and the attempts to explain them." (It is telling that he left out Steve Jones' neutron work.) In a summary statement (presumably written in 1993) that bears extremely poor relation to the evidence and discussion in this compendious *Proceedings* or what evidence built up later, Schneider wrote, "Some of the measurements reported herein appear to be artifacts, unreproducible results, or mistakes. At this time, no clear evidence exists that 'excess heat' is a result of a nuclear process." He ended with this disingenuous refrain: "My hope is that this *Proceedings* will help those interested in the history of this controversial subject better understand both the degree of scientific uncertainty

and the chaotic state of knowledge that existed at the time this workshop was held." Schneider, the so-called "Managing Editor," made sure that these proceedings were stamped "not intended for wide distribution," a mockery of his earlier phrase, "frank and open scientific discussion."

If a cold fusion colleague hadn't thought to violate the ban against dissemination, I would not have been able to prepare this account. Since learning of the publication, I have heard from a government official, who attended this meeting, that there had been threats of lawsuits if these proceedings were widely circulated. I do not know precisely who these unhappy parties might be, but they could not be those interested in the honest investigation of cold fusion or its history. This is the bottom line: The data and discussions included in this report lead to nothing less than *proof* that the then imminent DOE killing of cold fusion research was utterly wrong-minded. There was simply too much evidence presented—nuclear scale excess heat, tritium, and low-level neutron emissions—to leave any doubt that the matter deserved continued, intense investigation. With the passage of one more year the *public record* would leave virtually no doubt about the reality of the cold fusion phenomena. Those who took part in the official DOE rush-to-judgment later in October 1989, including at least one individual present at the EPRI-NSF meeting, Professor Alan Bard of the University of Texas, are guilty of egregious malfeasance in their civic and scientific responsibilities.

Curiously, though fifty attendees are listed in the report (sixty were invited), only one member of the DOE's cold fusion panel, Alan Bard, attended. Prof. Mark Wrighton of MIT's Chemistry Department (another DOE Cold Fusion panelist) was invited, but did not attend. MIT Plasma Fusion Center's (PFC) Dr. Richard Petrasso *did* attend, and presumably later filled in Wrighton with his negatively biased observations. Though the report transcribes the scientific exchanges that occurred after each presentation, not one public comment from Petrasso appears on the record. There was evidently no need to do so—the "fix" was in. Wrighton and Petrasso, it may be recalled, have their names on the infamous "Phase-II Calorimetry" report from the MIT PFC, which was touted as a null result but wasn't.³ The *Proceedings* show that Bard offered the MIT PFC result and Caltech as two of five negatives for excess heat. Two other of

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the “negatives” for excess heat, University of British Columbia and Sandia Laboratory, have not claimed major significance against cold fusion since that time. And another, the experiment of Dr. Melvin Miles of the Navy, was cited as negative by Bard, which was then certifiably out-of-date information, as it turns out. Miles initially got negative results in his calorimetry, and subsequently brought to the attention of Bard *et al.* that he had, indeed, achieved excess heat runs. Miles’ results were also incorrectly cited as negative in the final DOE report.

Why Wade Through This Muck?

It is a pleasant winter morning here in New Hampshire and I really should be out in the elements enjoying life. Instead, I find myself digging through evidence from a grizzly crime scene of years past—the rush-to-judgment against cold fusion of 1989. There is more than enough evidence in this 600-plus page tome to condemn the perpetrators, but the American people, who paid for much of the work documented in the *Proceedings* (the specific contract numbers under which the reported research was carried out are given), are not allowed to read the evidence or even to obtain a copy of it—except illicitly. *You* will not be allowed, except by this summary, to see for yourself the true state of knowledge about cold fusion that existed just prior to its official killing by Huizenga *et al.* That makes the crime so much worse. It is infuriating.

There were many important players at this meeting from those who were then and subsequently on the “pro” side of the cold fusion debate—John Appleby, John Bockris, Scott Chubb, Martin Fleischmann, Robert Huggins, Yeong E. Kim, Mike McKubre, Howard Menlove, George Miley, Richard Oriani, Stan Pons, Ed Storms, Carol Talcott, the late Kevin Wolf, David Worledge, and the late Ernest Yeager, to name the more prominent ones. Well-known critics included of course Alan Bard, but also Nathan Lewis of Caltech, the silent Richard Petrasso, EPRI’s Thomas Schneider, and excess-heat opponent Steven E. Jones. Also attending the meeting were two science luminaries, who had not previously been in the public fray over cold fusion: nuclear weapons physicist Dr. Edward Teller and Dr. Paul Chu, from the University of Houston and the Texas Center for Superconductivity. Chu was a respected name in the then new field of high-temperature superconductivity, another solid state enigma which had fared much better than cold fusion due to its ease of reproducibility. The record shows that Teller and Chu were not convinced by the evidence, but they were struck by it—enough for one of them, Chu, to issue a joint press statement with Texas A&M’s John Appleby at the time: “Based on the information that we have, these effects cannot be explained as the results of artifacts, equipment, or human errors. However, the predictability and reproducibility of the occurrence of these effects, which are common for accepted established scientific facts, are still lacking. Given the potential significance of the problem, further research is definite-



Paul Chu
Courtesy University of Houston

ly desirable to improve the reproducibility of the effects and to unravel the mystery of the observations.”⁴

Teller subsequently told the press that he recommended “in recognition of the high class work that yielded surprising results, that the efforts be supported to obtain clarification, whether the results are due to sophisticated difficulties in the experiments, or whether a new phenomenon is involved.”⁴ His transcribed words, now revealed by the *Proceedings*, were even stronger: “I am arguing for a continuation of an effort, primarily for the sake of pure science. And, of course, where there is pure science, sometimes, at an unknown point, applications may also follow.” (p.1-1). Weeks later, the negative DOE Cold Fusion Panel report would fly in the face of this sentiment.

In his introductory remarks at the beginning of the conference (p. 1-1 and 1-2) Teller further noted: “. . . the history of science and experimental physics is full of examples of predictions that things are impossible and yet they have happened. I remember what Ernest Lawrence once said about me: ‘When Teller says it is impossible, he is frequently wrong. When he says it can be done, he is always right.’ But what if we are presented with the fact that the results are correct? Then we will have to ask ourselves what are the minimum changes which we would need to make in



Edward Teller
Courtesy Lawrence
Livermore National Laboratory

nuclear physics to explain the facts. If the giraffe exists, how does his heart pump blood into his brain? If the results are correct, then you must assume that nucleons can interact not just when they touch. We need to be able to explain how the nucleons interact at distances as great as 1/10 of an angstrom. . . This would be a scientific discovery of the first order,

the kind for which we are willing to spend 5 x 10⁹ dollars (Superconducting SuperCollider). I therefore applaud the National Science Foundation and the Electric Power Research Institute for maintaining enough interest and enough support so that a real clarification of the apparent contradictions can be pursued.”

Later in the meeting, during a talk on “Catalytic Neutron Transfer,” in which he whimsically proposed an imaginary neutral mediating particle, the “Meshuganon,” to facilitate cold fusion phenomena, Teller said this about the importance of the overall effort (p. 23-2): “My conclusion is that the experimental work on ‘cold fusion’ should continue until a decision is obtained. The Meshuganon may give a possible but not a probable explanation. In any case, the experimental observations, if they are confirmed, must be explained by means that are outside of conventional nuclear physics.”

Taking a different tack on theory, Scott and Talbot Chubb of the Naval Research Laboratory later in the session opined (p. 29-1): “‘Cold Fusion’ can be explained in terms of known quantum mechanical effects that become physically realizable in a well-defined limit within a solid. Furthermore, the

extraordinary circumstances associated with the prolonged overcharging of Pd electrodes by Fleischmann and Pons suggests that in fact this well-defined limit may very well have been obtained during the experiments." Both the Teller and Chubb lines of theorizing have persisted to this day.

Someday, an enterprising group may succeed in getting this full EPRI-NSF report sprung into the public arena, perhaps by a Freedom of Information Act (FOIA) request. Good luck! Though in many cases federally funded research is being reported, the *Proceedings* are marked, "Copyright 1993, Electric Power Research Institute. All rights reserved." For now you'll just have to be satisfied with some additional fair use extracts and observations, to wit:

- Critics Alan Bard and Nathan Lewis think that modern heat measuring calorimeters can only to be trusted at the 5% error level! Lewis (p. 2-9): "The measured excesses are actually very small (10-30% of total input power) in most instances, and in most cases, the observed heating power is less than the total input power. Only if no recombination is established, and accurate calibration is demonstrated, can these values be considered trustworthy. It would be far better to build a calorimeter in which the claimed 50 W of excess power yielded a result that was a factor of 2 to 3 higher than the calibration curve, not a mere 5 to 10% higher." Error bounds on carefully done calorimetry are far better than this—an order of magnitude or more better. Later came this inane and preposterous statement from Bard, (p. 14-5): "Calorimetric data must always be shown graphically, including error bars. These errors are often much larger than we would normally expect. When we performed some calorimetric measurements in our laboratory with less care than usual, we obtained errors of $\pm 5\%$. In my view, this would not be an unusually large error in many calorimetric experiments." So, Bard (or his students) performs a deliberately inept—"with less care than usual"—experiment and then states that this $\pm 5\%$ would not be an unusually large error! Since helping to kill off cold fusion with this kind of irresponsible stupidity, Bard has been observed traveling on the lecture circuit against cold fusion as "pathological science," in speeches from Boston University to Illinois.

- The late Kevin Wolf of Texas A&M's Cyclotron Institute and Chemistry Department clearly asserted that his tritium evolution experiments could not be due to contamination—quite a different story than what he would say in the public arena during the furor over tritium at Texas A&M provoked by science journalist Gary Taubes in June 1990.⁵ From Wolf's paper (p. 8-1): "The sudden appearance of tritium activity in the cells requires the tritium to be loaded in a component prior to the beginning of cell operation in a contamination model. Release is assumed to be caused by deterioration of one of the materials used in the 0.1 M LiOD solution. In an extensive set of tests, no contamination has been found in the starting materials or in normal water blanks."

- Perhaps one of the most remarkable papers at the meeting was by Debra Rolison and William E. O'Grady of the Naval Research Laboratory, "Mass/Charge Anomalies in Pd After Electrochemical Loading with Deuterium." It was a strong hint of things to come in the cold fusion field—the discovery of heavy element transmutations on and in CF cathodes. Their abstract, in part (p. 10-1): "Our approach has been to explore the surface character of Pd foils after extensive electrolysis of H₂O or D₂O solutions. Our experiments

with the electrolysis of Pd foil in D₂O did not produce large neutron fluxes, and due to the small volume of the foil, calorimetric measurements were precluded. However, surface analyses by time-of-flight secondary [ion] mass spectrometry (TOF-SIMS) of the electrolyzed Pd revealed anomalies with electrolysis. TOF-SIMS was used to survey the effect on the Pd isotopic distribution with electrolysis in D₂O and H₂O. We report here an enrichment of m/z 106 and a diminution of m/z 105 in the surface/near surface layers of Pd electrolyzed in D₂O. No enrichment of m/z 106 was observed for the starting Pd material or for Pd electrolyzed in H₂O." The researchers proved that the anomaly was a surface and not a bulk phenomenon. After this high quality research, the tritium results from Storms, Talcott, and Wolf, not to forget the various high quality nuclear-scale excess heat measurements reported at the EPRI-NSF meeting, alarm bells should have gone off in the minds of the critics, but this did not happen. The critics, bent on killing cold fusion, not exploring a scientific frontier, were allergic to the facts. Moreover, the meeting was not open to public scrutiny by science journalists and others. The critics did not have to answer to the facts; these remained hidden.

- The paper of C. Talcott, E. Storms, R. Jalbert, and M.A. David, all of Los Alamos National Laboratory, was most impressive (p. 13-1). Storms was emphatic about the group's results right up front: "Let me begin this note with a conclusion: I see no way that the large (10^3 to 10^6) tritium values reported throughout the world could be in error. The smaller values (10^2) type range requires more scrutiny, but even those are unlikely to be in error." Interesting and impressive are the credentials of Roland A. Jalbert, whose background, presented in a prominent slide by Storms, is seen to be deeply rooted in the tritium measurement establishment of the hot fusion program. "Roland A. Jalbert: twenty-five years working with tritium and tritium detection; involved in development, design, and implementation of tritium instrumentation for fifteen years; for twelve years he has had prime responsibility for the design, implementation, and maintenance of all tritium instrumentation at a major fusion technology development facility (Tritium Systems Test Assembly); Consultant on tritium instrumentation to other fusion energy facilities for ten years (Tokamak Fusion Test Reactor at Princeton)." Where were the minds and ethics of the hot fusioners of that time as they marginalized the tritium results performed, in part, by one of their own?

Bashing the Meeting

It is bad enough that the EPRI-NSF meeting was closed-door and that the *Proceedings* were delayed and then covered up. But the circumstances surrounding the meeting now acquire a more sinister aspect. This is what I wrote in 1991 in *Fire from Ice*¹ about the context of this meeting:

"Ironically, at the same time the DOE cold fusion panel was finalizing its harsh, negative report. It met on October 30 to produce the final dark score, but before that meeting, co-chairman Huizenga was already telling the press that he didn't expect any changes from the July interim report. He told Jacobsen-Wells of the *Deseret News* in referring to the EPRI-NSF meeting, 'That was a very minor group of people who had been getting positive results for some time.' Even within NSF there was dissent. Marcel Brandon, director of the

EPRI continued on page 70

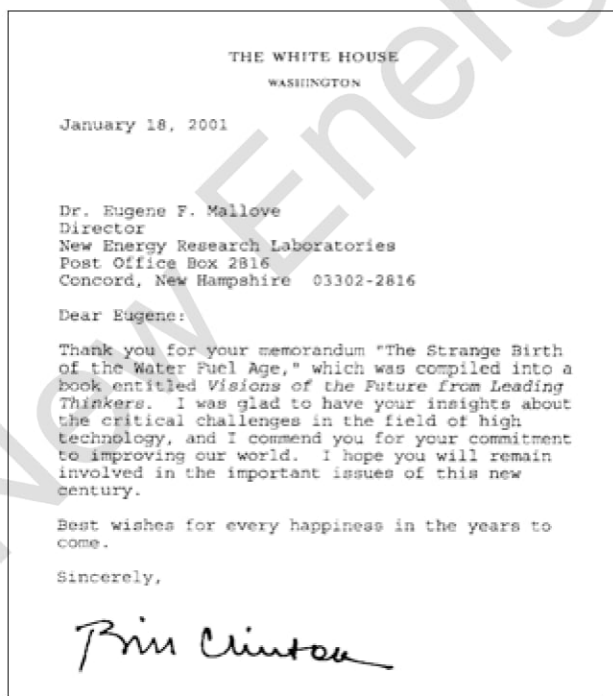
ECLECTIC OBSERVER

Compiled by Eugene Mallove

No Pardon for Cold Fusion

With the advent of the George W. Bush Administration, we enter the fourth Presidential term during which cold fusion has been at issue. When President Bill Clinton left office on January 20, 2001, he had just signed some 140 presidential pardons for various felons and fugitives from justice. At least a few of these pardons have been controversial to members of both political parties. But Bill Clinton did not choose to "pardon" cold fusion, figuratively speaking, though he could easily have done so, as he had been asked. He did not even grant it a new trial. Elaborating the analogy: Cold fusion was certainly "tried and convicted" by a rush-to-judgment kangaroo court set up under the U.S. Department of Energy back in 1989. The sentence: No reconsideration of the 1989 DOE findings, no matter what the substantial new evidence. The harsh judgement evidently still stands. An attempted dialogue with the Office of Science at DOE is the latest of failures to get a "pardon" (see the next item in this month's column).

On January 24, 2001, I received in the U.S. mail a personally signed note from President Bill Clinton (not apparently autopen or a copy), a reply to my 8,500 word memorandum on cold fusion. The White House Office of Communications had requested this memorandum in a telephone call to me in February 2000, thanks to the suggestion by Sir Arthur C. Clarke. (The memorandum is now posted on www.infinite-energy.com.) The reply note from Bill Clinton is on White House stationery, measuring about 9" x 7" and embossed with the Presidential seal.



Though I am delighted to receive an acknowledgment from the now ex-President (the note was signed on one of his last last days in office), I would have appreciated a more substantive response—something akin to a Presidential pardon for cold fusion. The Executive Summary of my essay made this simple request of the President: "Mr. President, you need do only one thing now: Publicly state that you are going to investigate this matter and then do it." This was not done, nor do I expect that private citizen Clinton will be found doing anything to correct the abuses foisted on us by the Department of Energy or the U.S. Patent Office, problems which began in the Bush Administration in 1989 and which will no doubt be continued for some time in the George W. Bush Administration. The political establishment will, of course, eventually be forced by development of the technology in the private sector to react in some way.

The Unbearable Heaviness of Being DOE

As many correspondents with people in the Department of Energy over the past dozen years have learned, on the matter of cold fusion it is impossible to move an immovable object, even if "infinite force" is applied. The sequence of communications from cold fusion inventor Evan Ragland, reprinted below in part, illustrates this point well. The upshot is that the request for assistance by U.S. Senator Trent Lott (Senate Majority Leader) wound up on the desk of MIT Professor Mildred Dresselhaus, who has been serving as head of the Office of Science within DOE. Though Dresselhaus knew quite well that, at the very least, the DOE's 1989 report is in need of serious updating (see *Infinite Energy*, No. 32, p.43), she as collaborator on that report defends it with the same intransigence of those who preceded her. Hers is both a failure of nerve and of scientific integrity, to put it bluntly; it is hard to tell which. We could have hoped for better from Dr. Dresselhaus. The story, as revealed by Ragland's correspondence:

January 25, 2001

Letter from Evan Ragland to Eugene Mallove

Dear Gene,

This letter covers transmittal of copies of correspondence from my Department of Energy (DOE) file. The 19 October letter from [Senator Trent] Lott to [Secretary of Energy] Richardson follows an earlier unanswered letter. It seems Richardson turned the matter over to Dresselhaus to answer. Her response of 15 November to Lott stonewalled the matter back to ERAB and Tathwell, a public relations type who I suppose is spin maestro to Congress.

The whole matter outrages me. The Department of Energy has made a clear public statement authorized by DOE Director Krebs that, "no imagined increase in the price of fuel oil can be compared to the (explicitly stated in the memorandum) concern for widening racial divisions among our citizens." Other Departments in the U.S. Government declare this memorandum and its "politically correct" reasoning to be United States

energy policy and therefore grounds to deny American citizens their Constitutional rights. It is scandalous that neither the DOE nor the Congress will publicly deny the Miller Memorandum is United States energy policy.

Dan Harris, Lott's legal counsel, has been handling this matter for Lott. His disposition seems to be simply to get the matter out of Lott's in basket. The easy way out is to accept that the Miller Memorandum—demeaning increases in energy prices—is official United States energy policy.

To me, it is unconscionable for the DOE and Congress to make and endorse a U.S. energy policy that avows, "no imagined increase in energy prices," is of concern. Dresselhaus' message to Lott for you folks in New England, the Midwest, and California is, "Let them eat cake in the cold and dark."

Yours very truly,
Evan Ragland

October 19, 2000

Senator Trent Lott Letter to Energy Secretary Bill Richardson

Dear Bill:

I am taking the liberty of contacting you further on behalf of my constituent, Mr. Evan Ragland, regarding his efforts to find out if the enclosed "Miller Memorandum" outlines your department's position on cold fusion.

Although I just recently contacted you concerning this matter, I wanted to be sure that you had received the enclosed materials. I remain interested in this and would sincerely appreciate your doing everything possible to be of assistance.

Again, I sincerely appreciate your time and attention to this matter for me. With kind regards and very best wishes, I remain
Sincerely yours,
Trent Lott

November 15, 2000

Mildred Dresselhaus Letter to Senator Trent Lott

Dear Senator Lott:

I have been asked to respond to your September 25, and October 19, 2000, letters with an enclosure referred to as the Miller Memorandum, to Secretary Richardson regarding efforts by your constituent, Mr. Evan Ragland, to obtain a patent for "cold fusion." Specifically, Mr. Ragland inquired whether the Miller Memorandum states the Department's position on "cold fusion."

The Department of Energy's position on "cold fusion" was motivated by a November, 1989 report from the Energy Research Advisory Board entitled, "Cold Fusion Research." A copy of that report is enclosed.

The first two recommendations in the report are:

"The Panel recommends against any special funding for the investigation of phenomena attributed to cold fusion. Hence, we recommend against the establishment of special programs or research centers to develop cold fusion."

"The Panel is sympathetic toward modest support for carefully focused and cooperative experiments within the present funding system."

These recommendations were instrumental in formulating the Department's position on "cold fusion," which was to remain receptive to evaluating unsolicited research proposals on phenomena attributed to "cold fusion" and to consider funding for meritorious proposals within existing research programs and budgets. This position and mode of operation was activated in the 1989-1990 time frame and remains in place at this time. However, as has been the case for about the past eight years, no "cold fusion" research efforts are being supported.

Thank you for the opportunity to provide Mr. Ragland with information regarding the Department of Energy position on "cold fusion" research. If you have further questions, please contact Mr. Frederick L. Tathwell, Office of Congressional and Intergovernmental Affairs, on 202-586-6447.

Sincerely,
Mildred S. Dresselhaus, Director, Office of Science

November 29, 2000

Letter from Senator Trent Lott to Evan Ragland

Dear Mr. Ragland:

I wanted to write to you again with respect to our recent efforts involving the Department of Energy's position on cold fusion.

As a result of my inquiry on your behalf, I have received information from the Department of Energy which I am enclosing for your review. I would sincerely appreciate your looking this material over and letting me know if you have any questions or comments.

It is a privilege to have the chance to be of service, and I want to thank you again for giving me this opportunity to be helpful. With very best wishes, I remain

Sincerely yours,
Trent Lott

December 8, 2000

Evan Ragland Letter to Senator Trent Lott

Dear Senator Lott:

Thank you for your earnest attention to my problem, for your 29 November letter, and for a copy of Mildred S. Dresselhaus', Director of the DOE Office of Science, response to your request of Secretary Richardson for review of the Miller Memorandum policies. You asked for my questions and comments.

How can it be with all time high energy prices, stage-3 rolling blackouts in California, fuel oil shortages in New England, and declining domestic energy production that the Department of Commerce recites on authority of Dr. Martha Krebs, Director, Office of Energy Research, Department of Energy (DOE) national policy that:

1. energy waste [radioactive] disposal is low priority
2. energy research is even lower priority
3. imagined increase in the price of fuel oil is not threatening, and
4. for the most part the Department of Energy is a "whistler in the wind" on energy policy?

The above list is a digested summary of Miller Memorandum excesses. Professor Dresselhaus' letter acknowledges the Miller Memorandum, but offers no comment on its policies. Rather, she directs attention to the funding recommendations, (1) and (2), of the November 1989 Energy Research Advisory Board (ERAB) Cold Fusion Panel report. All my research is commercially funded. I do not seek DOE funding. Further, the technical recommendations, (3), (4), (5), and (6), of the 1989 ERAB report are fulfilled by eleven years of cold fusion research—recommendations (4) and (6) are theoretically confirmed. There are no neutrons and excess heat correlates with tritium and helium-4 ash.

The Memorandum implies problematic energy policy is Congress' fault (see 4 above) and suggests voter correction. Also on page 1, it extends Dr. Krebs' position on the nature, scope, and importance of cold fusion to read, "and/or cold-fusion-like phenomena." Robert Spar, Patent Office, Director of Special Programs, exercised this definition by withdrawing U.S. Patent No. 6,024,935, issued to Randell Mills and Blacklight Power on 15 February 2000, because, "[it] was based on 'unproven science' related to cold fusion." [Bold emphasis is mine.] For a detailed discussion of this and background on Dr. Dresselhaus see *Infinite Energy* magazine copy, pages 43, 44, issue 32, July /August, 2000, included herewith.

Patent Office citation of the Miller Memorandum and the ERAB report obstructs cold fusion research. Reassessment of DOE cold fusion policy is long overdue. It is time for Congressional intervention.

Yours very truly,
Evan Ragland

Eclectic Observer continues on page 70

Book Reviews

JAMES LOVELOCK

HOMAGE TO
GAIA

Homage to Gaia: The Life of an Independent Scientist

by James Lovelock
ISBN 0-19-286213-8

\$US approx. \$16.00

Hardcover, 396 pp.

Oxford University Press, 2000

Review by Soo Seddon

"Why is it acceptable for creative folk like writers and artists to work in solitary, but creative scientists who choose to work alone are regarded with suspicion?"

The question is a good one and even knowing the answer didn't deflect James Lovelock from singlemindedly pursuing his ambition of becoming an independent scientist "unfettered by direction from anyone."

Lovelock's stubbornly determined streak first surfaced when, as a rebellious schoolboy, he flatly refused to do any homework whatsoever, and revealed itself many times in later years when he was presented on several occasions with tempting offers of sizeable salaries with job security—all of which he resisted in favor of his garden workshop and intellectual freedom.

How he eventually achieved the longed-for independence is revealed in fascinating and, at times, intricate detail in his intriguing autobiography.

His first job, with a London firm specializing in the chemistry of photography, was where he learned to regard accuracy in measurement as "sacred." He became so proficient that in subsequent years as a student at Manchester University he was accused of cheating because he submitted test results that were considered too perfect and far beyond the levels of accuracy that were expected from a mere student.

In 1941, he joined the Medical Research Council, where he studied the transmission of airborne infections. He transferred, after the war, to the Common Cold Research Unit in Salisbury, Wiltshire.

In 1949 he travelled to the Arctic on board the research ship HMS Vengeance, which was his first of several such voyages to far flung regions. Lovelock clearly adored the sea and never passed up an opportunity to sail.

Over the years he held consultancies with Harvard, JPL, and NASA. He worked with the lunar exploration team on refining gas chromatography in the 1960s and spent a lot of time in the U.S. While he declares himself to be eternally grateful to various U.S. agencies for facilitating and supporting his independence, in the manner of a typical Englishman he is scornful of the American ability to provide one of life's necessities. "Their tea," he writes "is anaemic stuff which tastes like it was exhumed from the bags thrown into Boston Harbor."

It was in 1957, while based at the National Institute for Medical Research, that he invented the electron capture detector, an event he regards as one of the most important milestones in his life as a scientist.

This compact, highly sensitive piece of apparatus enabled for the first time the detection of global pollution and led eventually to international agreement on protocols for the use of pesticides and propellants.

He received no royalties from his ECD patent, which was "seized" by the U.S. government in 1964.

He still can't believe that his ECD hasn't been replaced by something more high tech and is astonished that it is still in common use and that new applications are being found for it all the time.

The ECD was one of the premier weapons in what Lovelock refers to as the "Ozone War," when fierce battles raged between the green lobby and several major chemical companies.

Surprisingly, for one hailed as an environmental saviour, he is scathing of many members of the green movement. Most, he says, are not only ignorant of science but actively despise it. This, as he notes, doesn't prevent them from reaping the benefits of scientific research to substantiate some pet theory or other when they deem it convenient.

His initial paper on CFCs was first published in a journal edited by a friend of his. He specifically chose this publishing route as a way of "cutting through the tedious procedure of satisfying the self-appointed tyranny of the peer review process."

If he thought his early treatises on earth sciences might meet with some hostility, it was only when he published the first Gaia book in 1979 that he really felt the scorn and venom of the "abominable no-men of the peer review system."

Novelist William Golding, a neighbor of Lovelock, coined the name Gaia for his theory—a name which many scientists have problems with and which, like the term "cold fusion," tends to bring some of them out in a nasty rash.

Cold fusion gets a brief mention in the book. Back in 1975 he was asked to assist with some instrumentation to be used on the Mars Viking probe, a combined gas chromatograph and mass spectroscopy; his remit was to find a means of separating detected substances from the carrier gas, work that necessitated Lovelock using Pd and hydrogen.

His observations, he believes, reveal a major flaw in cold fusion theory. He writes:

Pd will store as much as 60% of its inner atomic space with hydrogen and this readily happens when Pd is made the negative electrode in a watery solution. A piece of Pd filled with hydrogen is stable for a while in air but there is often a surge of heat as the stored hydrogen reacts suddenly and catalytically with the oxygen of the air. It was this, I think, that led to the false conclusion that CF had occurred. [Editor's Note: We respectfully point out that the "recombination" issue, which Dr. Lovelock asserts, has long since been thoroughly disproved as an "explanation" for excess heat in cold fusion, but we invite this esteemed scientist to expand on his thoughts in a future issue.—EFM]

In 1991, a Norwegian benefactor donated £75,000 to the Gaian cause and three major conferences were organized in Oxford, England. This series of prestigious gatherings raised

the profile of Gaia theory and helped considerably towards establishing its credibility.

James Lovelock, FRS, is the recipient of many awards and acclaim for his work and inventions over the years. His trophy collection even includes a rare letter of apology from John Maddox (then Editor of *Nature*) that one of Lovelock's early Gaian treatises had been summarily rejected without review.

His best discoveries, Lovelock says, came from doubting conventional wisdom and he strongly recommends this course of action to all seekers of scientific truths.



Charging Ahead: The Business of Renewable Energy and What It Means for America

by John J. Berger
ISBN 0-520-21614-8
\$18.00 Paperback, 416 pp.
University of California Press, 1997
Review by Jon Norris

Charging Ahead is a good introduction to the history, politics, and economics of renewable energy in the U.S. While not encyclopedic in scope, it does cover the history and development of solar, wind, biomass, and geothermal energies in some detail. It also outlines actions that could move us toward greater energy independence and a cleaner environment.

Berger begins with an overview of the energy situation in the U.S. as of the late 1990s. He examines our dependence on oil from strategic, economic, and environmental perspectives. He looks at the perceptions of alternative energy research and development and shows how the current stranglehold on policy by oil and nuclear interests has stunted development of alternative energy sources and created the perception that alternative energy consists of failed technologies.

Beginning with solar energy, Berger examines the plants created by LUZ that are supplying hundreds of megawatts to the citizens of California. He moves on to photovoltaic, wind, bioenergy, geothermal, and finishes with a look at electric vehicles and increased efficiency through technological advances. He barely mentions fuel cells in discussing biomass, and does not look at low head hydro, tidal, cold fusion, or any other exotic or experimental sources at all. In each area, he examines the economic factors, the role played by energy policy, and public perception, as well as the scientific and technical obstacles encountered. He includes significant statistical and technical background material, and looks closely at the cost/benefit picture of these energy sources. It is clear from this book that these forms of alternative energy are far from being failed technologies, and indeed can offer workable options now and in the future.

He ends the book with a section on creating a better energy future, and gives sources for additional information and activism. There are thirty pages of citations and sources, and Berger's ideas seem well-supported by history and proven technology. His writing is clear and engaging, and the book is an easy read, despite the amount of technical information

included. I consider it to be a good look at alternative energy sources in our current market and political climate. The lessons of these energy pioneers would be very useful in any strategy involving cold fusion or other technologies. Berger does not waste lots of ink blasting the oil and nuclear industries, but he does not let them off the hook for their place in the current energy boondoggle. I find his approach to be balanced, measured, and optimistic.

This is a good book to remind us that there already are alternatives to oil and nuclear energy, and that much good technology sits relatively unused right in front of us. It points out how technological development needs supportive public policies in order to become a viable option in the marketplace. It also shows how single-minded pursuit of very narrow energy policies can create a disastrous energy picture, with rampant waste, environmental damage, and other political and economic nightmares. Anyone interested in energy use in our society would be well advised to read this book.



Extraterrestrial Contact: The Evidence and Implications

by Dr. Steven Greer
ISBN 0-9673238-0-0
\$19.95 Paperback, 526 pp.
Crossing Point Publications, 1999
Review by Mike Carrell

Dr. Greer's fascinating book is a compilation and summation of the work of the Center for Study of Extraterrestrial Intelligence (CSETI). This is distinct from SETI, the Search for Extraterrestrial Intelligence (similar pronunciation), which is based on scanning the electromagnetic spectrum with sensitive receivers, looking for intelligent signals from space. In Greer's view, ET interaction with mankind has been going on for decades and is an object for systematic study. Dr. Greer is CEO of CSETI, recently retired from a position as the head of a hospital emergency room.

Dr. Greer and CSETI have worked for a number of years compiling eyewitness accounts of extraterrestrial activity from reliable observers and from formerly classified government documents obtained under the Freedom of Information Act. In addition, he has obtained the cooperation of individuals working in or retired from the "military-industrial complex" who he says have direct knowledge of ET activity, the U.S. government's awareness of ET activity, and the significant network of unacknowledged programs which have grown up around ET activity. He has knowledge of some 150 military and government witnesses, many with top secret access, who can testify if existing draconian secrecy orders are lifted. The qualifications of a sampling of these are presented in the book.

Evidence is presented in abundance. There are a series of high quality reports compiled in the recent decade concerning well-authenticated encounters with alleged ET phenomena, and four representative photographs. What sets CSETI's work apart from some others are methodical organization, classification, and systematic building of inferences. Most

provocative of the encounters are those classified as Close Encounters Type 5, or CE-5. These are instances where people have sighted ET craft at close range and mentally asked for a closer look, followed by immediate response from the craft, often doubling back for a "look at me" before going about its' business. CSETI has developed protocols that have developed into extended CE-5 events involving groups of people.

ET features in the evidence include sightings of massive machines with the capability to accelerate at an extraordinary rate; selective interference with automobiles and recording equipment; appearance of glowing spheres in the near vicinity of observers; projection of thought impressions; appearance of humanoid beings at a distance and emerging nearby as if from a mist. All this can seem improbable, magical, or as evidence of very advanced technology.

Implications of the evidence are profound. They are best stated in the book, but I will attempt a faithful synopsis. Earth has been surveyed by one or more extraterrestrial civilizations for decades, perhaps centuries. There is no hostile intent in any of the encounters. Where there has seemed hostility, the events could be equally interpreted as defensive against human military aggression or misinterpretations (*e.g.*, of the nature of: an injured child taken to a hospital emergency room; a pet to the vet; or hunters sampling the local fauna). The surveillance increased during World War II, where the phenomena were seen as potential threats and evidence was classified. There were crashes, artifacts recovered, and extensive attempts to reverse-engineer advanced technologies from these artifacts in the expectation of advanced energy sources and weaponry. In the tense decades following World War II, it was feared that similar opportunities would fall to potential enemies, and the entire enterprise became cloaked in very deep secrecy, to the point that the existence of these programs was officially unacknowledged, classified beyond the access or supervision of elected officials. "Sir, there is no such program." The secrecy feeds on itself. To offset the continued ET sightings and encounters by civilians and others, an extensive disinformation campaign is in operation to minimize reports, ridicule observers, and present those who state what they saw as ignorant or deluded.

A purpose of CSETI is to bring about a formal disclosure by U.S. government officials of the existence of ET interaction with mankind over the last fifty years of systematic observation and study by the U.S. and other governments.

Dr. Greer has briefed high government officials, using his compiled evidence and videotapes. One of the most interesting was a closed-door briefing April 7-11, 1997 in Washington. Invitations went to White House and Congressional members and staffs. Presentations included evidence collected by CSETI and testimony of selected witnesses. Government officials did not endorse the meeting, but the agenda, witness, and guest list were conveyed to government officials in advance and unofficial permission to proceed was received.

The book contains copies of letters to government officials, including President Clinton, urging that the security restrictions be lifted. There are seventy-one pages of such letters and reproductions of declassified documents pertaining to ETs. Despite official government comments that there is no interest in ETs, CSETI has logged visits from: 22 U.S. military branches; 48 government laboratories and agencies; 13

aerospace companies; 32 defense contractors; 15 high tech companies; 22 other U.S. companies; 32 overseas visitors, and other university visits too numerous to mention.

Clearly, the ETs manifest technologies seemingly so beyond the reach of humankind as to seem magical. The intent is obscure. The secrecy concerning ETs is deeper in the U.S. than elsewhere. In other countries ET observations are openly acknowledged and are the subject of investigation by official agencies. The whole extent of this is condensed within 525 pages of Dr. Greer's book and much too lengthy to detail here.

Commentary

Mistaken categorical arguments against twentieth century ET interactions with mankind include:

1. Einstein's Theory of Relativity, which is said to be well validated by twentieth century science, is mistakenly interpreted as demonstrating that it is impossible for a physical object, such as a spacecraft, to go faster than the speed of light in a vacuum. Therefore, space exploration and commerce are impossible where stars are light-years apart.

2. No compelling evidence for life, much less intelligent life, elsewhere in the Universe.

3. Insufficient energy sources for spacecraft to travel interstellar distances on a time scale which would allow two-way travel, thus exploration, commerce, and/or conquest within the life-span of beings we know about.

4. The nearest stars are light-years distant, probability of nearby life small in view of 2) and 3).

5. Eyewitness accounts are varied and often inconsistent, reporting phenomena so inexplicable by common misunderstandings of twentieth century physics, as to invite categorical rejection.

Dr. Greer made available to me videotape he uses in narrated briefings, containing a sampling of images of UFOs. Some of these appear very strong evidence in support of CSETI's findings.

My own very informal sampling of opinion among people that I encounter shows a bias toward accepting the ET evidence without fear or hostility. An opposing view is nurtured by media sensationalism, which markets strife and danger, feeding the territorial instinct of xenophobic humans, reacting against the presence of strangers who cannot be effectively opposed. Human history has instances of colonial "gunboat diplomacy." There is the indignity of finding our quarrelsome race in low status in the Universe. As to intent, one can reflect that ET evidence suggests the capability to steer an asteroid into the Earth at will, or disable all the satellites in an hour's work. That such has not been done is evidence of peaceful, non-hostile intent.

A more constructive view is that ETs may have been involved in nurturing mankind throughout its history. There are certainly enough clues in the mythology and religious traditions of mankind to support this view. The books of Erich Von Daniken are perhaps an extreme case. Some authors have suggested that modern technologies (such as fiber optics, integrated circuits, and such) are derived from ET artifacts and seeded into high tech corporations. In these specific cases, there is a consistent thread of these technologies leading back to roots in the nineteenth century. That such may have been found in ET craft indicates parallel development, not a serial dependency by mankind.

AGAINST THE TIDE



LESLIE C. WOODS

Against the Tide: An Autobiographical Account of a Professional Outsider

by Leslie C. Woods
ISBN 0-7503-0690-4
\$40.00 Hardcover, 319 pp.
Institute of Physics Publishing, 2000
Review by Thomas E. Phipps, Jr.

This account of the somewhat unusual life of an applied mathematician is of general interest. Born a fisherman's son in New Zealand, he flew as a fighter and dive bomber pilot against the Japanese in Rabaul on New Britain Island during World War II, then after the war overcame adversities to rise in the academic scrimmage at Oxford and elsewhere. Although he writes primarily to inform his own family, his story is of broader interest, as he possesses a generous fund of anecdote and experience to draw on. He tells it well—though not with the polish of a professional writer. The book is beautifully printed and presented, but—as is true of all modern books—it obviously lacks the refining textual attentions of an old-fashioned editor of the sort who knew written English. (Presumably that function has vanished forever, to give way to “production editing,” in the worst case by ingenuos innocent of the principles of grammar and organization but game as hell and determined to try. The buyer necessarily infers process from product.)

It is not for its general interest that I would tout the book to readers of this magazine. It is because, toward the end, a couple of chapters are included on “Struggles in Research” and “The Tokamak Fiasco.” As an applied mathematician, the author's interest focused on the sort of physical mathematics needed to describe the transport phenomena that characterize hot fusion plasma experiments. He became a world authority on this topic, was inspired to develop his own version of the theory of plasma diffusion across a magnetic field, as occurs in a Tokamak device, and published several books on the relevant mathematics. Being an outspoken fellow (one of nature's whistle-blowers), he made no secret of his finding that Tokamaks could never work—that is, produce more power than was input to them. Consequently, since billions in research dollars worldwide were at stake, he—a professional's insider if there ever was one—got the “outsider's” ignorance and shunning treatment that smells better to the higher-educated modern nose than burning at the stake. I find his words more telling than mine:

The evident failure of the fusion programme will never be admitted by those whose careers and livelihoods depend on maintaining the myth of “steady progress.” Scientific breakthroughs occur on schedule synchronously in advance of funding requests and progress is sanguinely recorded in glossy annual reports. [One professor] who had years of experience interacting with the group at Princeton University's Fusion Laboratory with its expensive and inefficient tokamak, likened the fusion enterprise to that of “reaching the moon in a balloon.” Each year minor improvements allow the balloon to rise a little higher, thus allowing claims for more funding.

There you have it: absolute lucre corrupts absolutely. We now know the status of physicists' integrity when impacted by the big bucks. Is it different with other sciences? Frustrated scientific innovators may join me in viewing this as the tip of the iceberg.

The Cold Fusion as a Space Time Energy Pumping Process¹

A.A. Nassikas

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The purpose of this paper is to explain cold fusion through the hypothesis of the Quantum Space-Time-Aether.^{2,3} This hypothesis is based on the unification of the physical meanings of the notions which derive from either GRT or QM. According to this hypothesis the quantum space-time-aether is matter itself; this facilitates the explanation of cold fusion phenomena since there exists infinite energy (aether energy) that surrounds the cold fusion apparatuses and which can activate the cold fusion phenomena.

Cold fusion technologies may be classified in two categories:

1. Technologies which imply a nuclear reaction; and these relate to the experiment of Pons-Fleischmann and their followers. In these technologies, we have cold fusion of hydrogen isotopes and nuclear transmutations.
2. The technology mainly described in Mills' patent, which is related to light water electrolysis; in this technology, according to Mills, we have reaction products (hydrinos) which do not correspond to our commonly known element energy states in nature.

Many explanations for all categories of cold fusion technologies have appeared. This paper aims to provide an explanation adequate for all cold fusion phenomena. This explanation is based on a space-time energy pumping process, according to which the approach of an electron to a proton results in pumping space-time-aether energy.

Pons-Fleischmann-like processes can be explained on the basis of the reaction of electrons with protons which produces neutrons and neutrinos. This reaction is strongly endothermic (-0.783 MeV). The energy of 0.783 MeV, according to a Conte explanation, approved by Mizuno,⁴ is covered by the electron capability to have—according to quantum mechanics—a presence probability under high energy as well as by the developing of an excess potential in very small distances between electron and proton. However, the energy of 783,000 eV is difficult to handle by means of low voltages. Thus, it is expected that the reaction mentioned is significantly facilitated by the gravitational space energy absorption during the approach between electrons and protons, which is used for the creation of the next stable state (neutron + neutrino).

Mills-like processes can be regarded as a result of conversion of space-time-aether energy into heat by approaching-distancing between proton-electron through unstable states under the first fundamental state of the hydrogen atom.

The pumped aether energy can be converted, according to a proposed experiment, directly into mechanical work. According to this experiment, the space-time energy pump can work by means of a hydrogen-loaded metal, which is activated through negative voltage electric pulses.⁵ The hydrogen-loaded metal is put in one side of a body; because of the absorbed aether, due to the space-time energy pump, we have in this side a decrease in aether density, i.e. in matter medium that creates the gravitation and a force creation towards the other side. This experiment has not been done and it is proposed as a verification possibility of the concept of the space-time energy pump.

Notes:

1. Presented at ICCF-8. Accepted for publication in *Nuovo Cimento Conference Series*-February 2001.
2. *Galilean Electrodynamics*, 2000. Special Issue 2, 36-40.
3. *Infinite Energy*, 3, 13/14, 120-124
4. Mizuno, T. 1998. *Nuclear Transmutation: The Reality of Cold Fusion*, Infinite Energy Press, Concord, NH.
5. Patent application No 990100439, Greek Organization of Industrial Property.

UPCOMING EVENTS

Forum 2001 Solar Energy: The Power to Choose

April 21-25, 2001
Washington, DC
American Solar
Energy Society
2400 Central Avenue Suite G-1
Boulder, CO 80301
Phone: 303-443-3130
Email: ases@ases.org

Midwest Renewable Energy Fair

June 22-24, 2001
Portage County Fairgrounds
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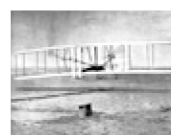
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The California Electric Power Crisis and Alternative Energy

Jed Rothwell

The big story this month in conventional energy news is the shortage of electricity in California. It is unclear how this energy crisis came about. Politicians blame the power companies for gouging the public, the power companies say they are bankrupt, businesses and the public are upset with the rolling blackouts. Most people agree that deregulation was poorly thought out, because it freed wholesale prices while putting a cap on end-user customer prices. California Gov. Gray Davis called deregulation a "colossal and dangerous failure" that had allowed "profiteering companies from out of state" to raise wholesale electricity prices by a factor of ten or more.

The crisis was exacerbated by a run of bad luck, as an unusual number of plants shut down for unscheduled, unexpected reasons. A nuclear plant ceased operations at the height of the power crisis after a storm at sea tore up kelp, which clogged the cooling water inlet.

It is not clear how much of the crisis is caused by lack of new generating equipment, and how much by economic and regulatory problems, and power company economics. No major power plants were constructed in the last ten years. In the early 1990s, most power companies said there was 30% excess generating capacity. This excess, plus improved performance from plant upgrades, met the demand for years. In the late 1990s demand grew faster than expected, and capacity fell behind. As power shortages grew, spot prices shot up. The utility companies began to lose billions of dollars. They soon became technically bankrupt, and out-of-state power companies refused to extend credit to them. Natural gas suppliers were demanding payment in advance from either the utilities or the state government. The financial crisis came to a head in January 2001 when PG&E defaulted on payment of \$726 million in short term debt. On February 6, the state government arranged a deal whereby it will buy electricity at \$60 to \$65 per megawatt hour, and sell it to the utilities. This compares to spot market prices as high as \$300 to \$500. The state allocated \$10 billion to fix what the *San Francisco Chronicle* called "the wreckage of California's energy deregulation plan." The state has been spending \$45 million per day in emergency allocations to buy power, which is more money than it spends per day on higher education.

The policy of capping consumer prices while freeing wholesale prices made sense, because it was expected that breaking up monopolies would lower power costs by 25%. This was a reasonable expectation; historically, over the long term, energy prices have always fallen. But others argued that capping consumer prices was totally self-defeating to deregulation.

The California Energy Commission table shows what happened in the last decade. From 1990 to 1999, demand



Photo: Barbara DelloRusso

increased moderately and steadily by a total of 9%. The *San Francisco Chronicle* quotes a higher estimate made by the Edison Electric Institute, that consumption grew by 4% percent in 1996 and 3.4% in 1997, and it suddenly spurted 10% in 2000. According to this table, in 1999 total demand was 23 billion KWH higher than it had been in 1990. In the meanwhile, imports fell by 12 billion KWH, geothermal fell by 3 billion KWH, and generation with oil stopped altogether. The difference, 44 billion KWH, was made up mainly by increasing electricity from hydroelectricity, coal, and gas.

Although overall energy imports fell 18% during the

California Electrical Energy Generation, 1990 to 1999
TOTAL PRODUCTION, BY RESOURCE TYPE
(Millions of kilowatt hours)

	1990	1991	1992	1993	1994	1995	1996	1997	1998 [†]	1999 [†]
Total	252,355	242,343	245,535	242,026	256,719	256,367	253,621	255,080	276,412	275,792
Hydroelectric	26,092	23,244	22,373	41,595	25,626	51,665	47,883	41,400	48,757	41,617
Nuclear	36,586	37,167	38,622	36,579	38,828	36,186	39,753	37,267	41,715	40,419
Coal	21,402	23,442	32,435	22,907	25,095	17,925	25,460	27,114	34,537	36,327
Oil	4,449	523	107	2,085	1,954	489	693	143	123	55
Gas	76,082	75,828	87,032	70,715	95,025	78,378	66,711	74,341	82,052	84,703
Geothermal	16,038	15,566	16,491	15,770	15,573	14,267	13,539	11,950	12,554	13,251
Organic										
Waste	6,644	7,312	7,362	5,760	7,173	5,969	5,557	5,701	5,266	5,663
Wind	2,418	2,669	2,707	2,867	3,293	3,182	3,154	2,739	2,776	3,433
Solar	681	719	700	857	798	793	832	810	839	838
Other	4	0	2	0	0	0	343	896	230	0
Energy Imports	61,959	55,873	37,704	42,892	43,354	47,514	49,696	52,720	47,563	49,487

[†] Preliminary.

[†] Revised.

Source: California Energy Commission, August 17, 2000
(916) 654-4921

1990s, imports are a problem today. California generally exports electricity to the north for heating during the winter, and imports electricity in summer to meet the demand for air-conditioning in Southern California. This winter it has been forced to import during December and January. The problem is aggravated because much of the power in Washington is generated from hydroelectricity and there has been a drought in the Northwest.

The cost of natural gas has shot up nationwide in recent months. Natural gas is an ideal fuel for low-pollution, high-efficiency electric power generation, and utility companies worldwide have been building gas-fired generators. Unfortunately, they have acted simultaneously without considering the fact that everyone else is doing the same thing, and the supply of natural gas is limited. About a third of California's electricity comes from natural gas, and most of the generators now under construction will use it. The consensus of opinion in mainstream newspapers seems to be that California must now rush to build huge centralized electric plants, which are mainly gas-fired. Unless the price of natural gas declines, in a few years this policy will ensure that electricity is plentiful but much more expensive than it is now.

It is disturbing that many newspapers are blaming the crisis on California's strict environmental regulations and its alternative energy initiatives. If alternative energy caused this problem, you would expect that alternative energy use would have increased during the 1990s, but instead it fell. Steadily increasing use of wind power during the 1990s would have averted shortages today. The cost of wind power has fallen 80% since 1980, and it is now 4 to 6 cents per kWh, nearly as cheap as coal, the cheapest conventional fossil fuel energy source.

The people of California invested a great deal in inefficient, first generation wind farms in the 1980s. The profit and know-how gained from these ventures led to today's gigantic wind generators, which are far more cost-efficient, quiet, and long lasting. According to the American Wind Energy Association (AWEA), wind now supplies 1,800 MW in California, and it will soon increase to 2,000 MW. The maximum wind generation capacity in the state is 6,000 MW, conservatively. Wind generation can be added more quickly than conventional sources; a 200 MW wind park can be built in one year, compared to two to three years for a fossil fuel plant, or five to ten years for a nuclear plant.

California's peak demand is 46,000 MW, so wind could meet only 13% of demand. Surrounding states have far more potential wind power. The AWEA says that the total wind energy potential of California, Nevada, Wyoming, Montana, Washington, and Oregon combined is more than 600,000 MW. However, some of the best sites are far from the cities that need the power, and far from existing power transmission networks. Building new power lines meets as much or more resistance from communities as new generator plants.

North Dakota, Texas, Kansas, South Dakota, and Montana together have enough potential wind power to generate all of the electricity used in North America. However, they are far from population centers in other states, and an electric power distribution grid cannot economically transmit power thousands of miles. Transmission losses might be reduced by using the electricity for electrolysis and then sending hydrogen gas through natural gas pipelines. The hydrogen could be used to generate electricity with fuel cells in cities, a

process which produces only water as a byproduct. Hydrogen leaks more easily than natural gas, so the pipelines would have to be re-lined on the inside. This can be done with existing techniques.

In January 2001, construction began on a 300 MW wind park in Wallula, Washington near existing power transmission lines. Another 260 MW plant is being built in Nevada. Both projects should be completed by the end of the year. A 200 MW wind park is being constructed in Southern California. This total of 760 MW is dwarfed by conventional power plants now under construction in California, which will supply 6,723 MW. However, the conventional plants have been underway for some time and they will not be finished until 2003; if the cost of natural gas remains high, they will produce electricity at much greater costs than the wind farms. The combined new construction of gas and wind generators would eliminate power shortages, except that about half the plants in California are over thirty years old and many may need to be phased out soon. California's oldest existing wind parks could be upgraded to produce far more electricity.

The AWEA reported that during 1999, more than 3,600 MW (3.6 GW) of new wind generators were installed worldwide, bringing total installed capacity to approximately 13.4 GW. This growth in capacity per annum is about the same as the growth of nuclear power in 1969 and 1970. Nuclear power reached its maximum growth in 1985, with 31 GW added that year. It reached its maximum total installed base of 328 GW in 1990, providing 17% of the world's electricity. At present growth rates of 30% per year, wind power will surpass nuclear power by 2025.

The *Chronicle* estimates that the energy fiasco has cost the citizens of California \$40 billion. That would be enough money to build 40,000 MW of wind parks in the neighboring states, nearly enough to provide pollution-free, zero-fuel, renewable electricity for the entire state of California, provided that on-demand gas generators are available for a fraction of demand, which may be needed when abnormal weather causes high or low winds, disrupting generation.

Sources:

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- U.S. Department of Energy, Hydrogen Program Plan
- Scientific American, September 1990, Special Issue, Energy for planet Earth Worldwatch Institute, <http://www.worldwatch.org/index.html>
- California Energy Commission, <http://www.energy.ca.gov/>

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GAS HYDRATES: Good News and Bad News

Bennett Daviss

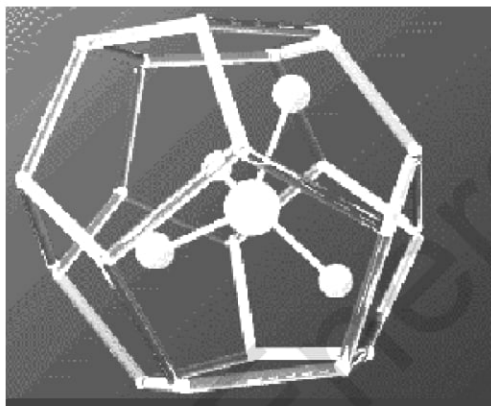
Trapped inside microscopic cages of water molecules, there is enough gas to enable the U.S. to meet all of its energy needs for a hundred years. But it might take us half that long just to figure out how to get at all that gas.

Our planet is littered with microscopic jewels of energy. Gas hydrates—cage-like crystals of water molecules with natural gas trapped inside—are scattered through the world's permafrost and seabed sediments as commonly as diamonds in a DeBeers mine. But, by comparison, hydrates make the other kind of gem seem downright easy to collect.

Gas hydrates hold a possible solution to the world's eternal energy crisis, tantalizingly just out of reach.

The U.S. Geological Survey (USGS) estimates that U.S. coastal sediments and the Alaskan permafrost alone hold a stunning 200,000 trillion cubic feet (Tcf) of natural gas. In contrast, the nation's conventional gas reserves are estimated to be about 1,400 Tcf. Worldwide, gas hydrates are thought to total 400 million Tcf—rendering pale by comparison the planet's currently known gas bank of 5,000 Tcf.

The abundance of hydrates is the result of nothing more than basic chemistry, according to Timothy Collett, the USGS's resident expert on gas hydrates. "These cage-like structures are water's natural reaction whenever gas is around," he says. "As pressure increases or temperature decreases, the bonds between the hydrogen atoms of water molecules become stronger until they form this solid, crystalline structure."



A gas hydrate crystal. The large carbon atom at the center has four hydrogen molecules attached. All are enveloped in a cage of water molecules.

Under Arctic lands or chilly seabeds, the combination of temperature and pressure are ideal for the hydrates to form. "These balanced conditions of temperature and pressure exist in virtually every part of the world's ocean basin with water depths greater than 500 meters," Collett adds. "They also exist in all of the world's permafrost regions starting at depths as shallow as 200 meters—and 23% of the world's land mass is underlain by permafrost."

Hydrates also don't rely on price shocks to look good. "We consider hydrates to be economically viable at a wholesale gas price of \$4 to \$6 per thousand cubic feet," Collett says. "That's a price range we probably won't go below for at least another two years. (In late January, wholesale prices dropped slightly below \$6 for the first time in two months.) There's also a National Petroleum Resource Council report from the 1980s that benchmarks production of hydrates at \$3 or \$4 on Alaska's north slope if a pipeline were in place to transport the gas."

But harvesting that energy isn't as simple as just scooping up the crystals. Most of the world's deposits range in concentration from 6% to less than 1% hydrates by volume. In other words, most of these gas fields are nothing more than dirt. To filter all that soil for a relative handful of gas hydrates would be a waste of money.

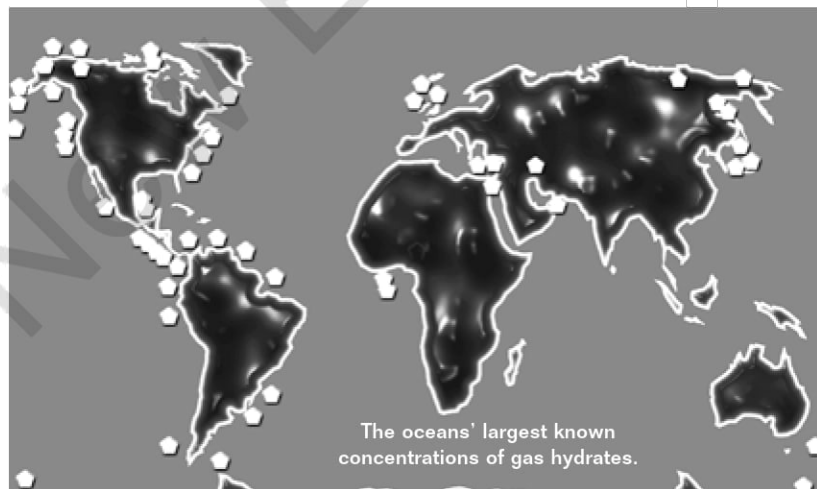
To make the resource pay, experts say, producers need to tap reservoirs with concentrations of at least 25 to 30% hydrates by volume. But that higher density brings on a new slate of problems.

Those problems have to do with stability. Hydrates exist when temperature and pressure are balanced in particular proportions. As hydrates are extracted from a reservoir, the deposit's internal pressure falls. As the pressure falls, the hydrates begin to fall apart.

That can make it harder, rather than easier, to collect the gas that's being liberated. In the seabed, hydrates serve as a sort of glue that holds the sediments of the deposit together. As the hydrates come apart, the submarine soils enveloping them could begin to slip and slide, destroying with dramatic suddenness the remaining balance of pressure and temperature. (Permafrost is a different kind of soil and presents few, if any, such dangers.)

In theory, the sliding undersea soils could suddenly belch huge clouds of gas out of the reservoir. Some fear that those clouds could spark an explosion or wellhead fire, or rise straight to the upper atmosphere and aggravate the greenhouse effect. (Natural gas is twenty-five times more effective at trapping heat in the atmosphere than carbon dioxide.)

It's a controversial point. Environmental groups have argued for the possibility, and on February 7 Svein Tveitdal, director of a United Nations Environment Programme center in Norway, reported that rising Arctic temperatures are causing "the permafrost in some areas to give



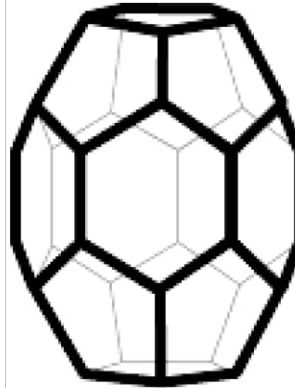
The oceans' largest known concentrations of gas hydrates.



One of the three most common stable forms of gas hydrates holds eight methane molecules for every 46 water molecules in the crystal. This shape can hold only the smallest gas molecules, such as methane and ethane.



Another common stable form of hydrate contains 24 gas molecules for every 136 water molecules in the lattice. This form can hold medium-size gas molecules such as propane and isobutane.



The third most common stable form of hydrate holds six gas molecules for every 34 molecules of water forming the surrounding cage. It can hold large, branch-chained gas molecules such as isopentane.

back its carbon" to the atmosphere. "This could accelerate the greenhouse effect."

However, Collett believes that "with modern reservoir monitoring methods, it shouldn't be a major problem." But if drilling or production equipment is anchored in those soils or sediments, the soils' sudden shifts at least could destroy pipe, pumps, and tools and scuttle economic viability of a hydrate venture.

To avoid these doomsday scenarios, engineers are investigating three distinct methods, all borrowed from secondary oil recovery techniques, to break down the hydrates and safely recover the gas. "If you can heat the reservoir while keeping the pressure constant, that necessary balance of pressure and temperature slips," explains Jagan Bontha, senior development engineer working on hydrate recovery at the Pacific Northwest National Laboratory. "The hydrates dissociate and you draw off the gas."

Alternatively, producers can accomplish the same goal by doing the opposite: liberate the gas by holding the reservoir's temperature steady but lowering the pressure. High concentrations of hydrates almost always lie near reservoirs of free natural gas. "As hydrates form, they usually consume virtually all of the water in the immediate area," Bontha explains. "Then the gas can't form any more hydrates and any remaining gas remains as free gas in the reservoir. By simply pumping out that free gas, the pressure within the reservoir drops and the hydrates begin to come apart."

The third, and least likely, technique is to pump a hydrate reservoir full of an "inhibitor," a chemical that interferes with the hydrogen bonds among the hydrates' water molecules.

"That can be a solvent like methanol, or a strong electrolyte like brine," Bontha notes. "The sodium and chloride molecules in brine start competing for the water molecules making up the hydrate cages. The structures weaken and the gas escapes."

All three techniques sound good, but they haven't moved past the talking stage yet—and won't for years, Bontha and Collett agree.

"When you try these methods in the lab, you see all sorts of wonderful results," Bontha says. "But once you get into practical applications, it's a different picture."

The problem isn't chemistry as much as economics. Only a relative few hydrate deposits show concentrations that are cost-effective to produce using current techniques. "Of the heat you would put into a reservoir to stimulate production,

in most cases 90% or more would go to heat rocks, not hydrates," Bontha says.

Similarly, whether inhibitors are useful depends on how far they travel into the reservoir. "Injecting inhibitors at a given point doesn't guarantee that hydrates will dissociate even 50 meters away from the point of injection," he adds.

"You might have to drill so many injection wells that the operation wouldn't be economically feasible."

The third way—depressurizing the rock—introduces another risk, related to something known as the "latent heat of melting." The energy to

dissociate hydrates has to come from somewhere. If the reservoir temperature is held steady while the pressure falls, then that energy is drawn from the reservoir rock itself, Bontha explains. "That cools the reservoir, the cooler temperature and lower pressure reach a new point of equilibrium, and the reservoir's production drops off. That takes the edge off the economics, which depend on a steady rate of production."

To skirt these quandaries, Bontha and his team have been working on a proprietary process that combines temperature and pressure stimulation to keep the reservoir in "the zone" while also dispensing with the need for outside heat. "Our process avoids putting heat into the reservoir and instead draws heat from the properties of the hydrates themselves," he says—"although this is not controlled combustion," which is sometimes used in enhanced oil recovery to heat a reservoir and loosen viscous hydrocarbons.

While Bontha labors, in 2002 an international team of government and oil company engineers will trek to Canada's Mackenzie Delta to visit the Mallik L38 gas well. Drilled by Imperial Oil Ltd. in 1972, the well shows at least ten separate layers of gas hydrates. The group plans to take rock samples and conduct an extended study of possible production techniques.

"We hope to start a production test within the next several years," Collett says. Future tests also are planned for wells in the Gulf of Mexico, where engineers will concentrate on devising ways to keep hydrate beds stable during production.

"We'll start learning in Arctic regions on land because we know them so well," Collett notes. "There is a thirty-year history of producing oil and gas from these reservoirs. In the marine environment, there's a thick water column overlying the hydrate sediments and, in many cases, drilling is just now reaching to the depths where these sediments lie. We don't have a lot of experience with them. The plan is to learn on land and then gradually transfer what we know to areas that we're not as familiar with."

Even then, "we don't know how much we'll ultimately be able to produce," he adds. "But if we can recover even 1%—and a lot of people believe there's at least a 99% chance we can do that—it will be an extraordinary amount of energy."

Bennett Daviss covers energy, science, and technology for several national publications.

Top Ten Energy Innovations for 2010

A panel of "experts," including those from Batelle Research Laboratories, the National Renewable Energy Laboratory, Pacific Northwest, Brookhaven, and Oak Ridge National Laboratories, recently convened for a "thinking out of the box" session to come up with predictions about the most important energy innovations and trends that will be emerging by 2010. This is the list they developed, which we summarize:

1. Restructuring the Energy Industry: SuperUtilities and energy companies will emerge as deregulation and competition force small utilities and oil companies to restructure or die.
2. Hybrid Vehicles: Already on the road, these vehicles, powered by combinations of small, efficient internal combustion engines and electric motors, will grow ever more popular.
3. Smart Energy Management Systems: Computers, the Internet, and GPS satellites will reduce traffic congestion, manage household and business energy use, and make more efficient the generation and transportation of energy.
4. Distributed Power Generation: Fuel cells, internal combustion engines, and microturbines will allow local power generation in residences and neighborhoods. Major regional blackouts become a thing of the past.
5. Fuel Cells: These will pervade the energy infrastructure, including smaller and cheaper fuel cells for portable and stationary power generation.
6. Gas to Liquid Conversion: Chemical engineering transforms hydrocarbons from gases into liquids, leading to more flexible use and storage of fuels.
7. Advanced Batteries: Power densities of batteries increase three-fold, based for example on lithium polymer technology.
8. Energy Farms—Genetically engineered crops allow enhanced growing of material for biofuels, such as ethanol.
9. Solar Energy: Substantial improvements over the next decade.
10. Methane Hydrate Crystal Mining: Mining of frozen natural gas crystals in hydrate form from the ocean floor produces a "quantum leap" in future energy.

The panel left out wind power, and of course did not mention cold fusion and other new energies, which we feel have a good chance of playing a major role by 2010. But these experts did come up with a fairly good guide to the conventionally understood trends over the coming decade. —EFM

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Corrections at the *New York Times*

Reed Irvine

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Twenty-eight years ago, the dean of the Columbia Graduate School of Journalism wrote an article for the *Columbia Journalism Review* in which he chided the *New York Times* for its frequent refusal to admit and correct its errors. He wrote, "The *Times* has no convenient place or easy formula for correcting errors today. Judging from mail that has been shown to me by offended citizens, it has a unit of staff members devoting virtually full time to writing letters explaining why a correction doesn't seem justified or why it would do more harm than good." When they were compelled to make a correction, the editors would try to do so without calling attention to the fact that the *Times* had made a mistake. That was often done by running another story in which information correcting the error could be included without identifying it as a correction.

In 1974, the *Times* made a bad mistake in running a leaked story about a National Academy of Sciences report on the effects of our military's use of defoliants in Vietnam. Much of the leaked information was erroneous. This was brought to the attention of the *Times*, but nothing was done about it. It was only after the matter was raised at the annual shareholders meeting two months later that an article correcting the errors was published. Few readers recognized this as a correction of an error-filled story.

Over time, the editors became a little more willing to admit mistakes. Corrections were frequently made by publishing letters to the editor. A correction box appeared every day on page 2, albeit it was devoted mainly to correcting such things as misspelled names and wrong addresses. Later more serious errors were corrected occasionally in an "Editor's Note." After a change of publishers two years ago, a 125-word limit was imposed on letters to the editor, virtually eliminating them as a means of making serious corrections. The difficulty of getting the *Times* to correct its errors was again raised at its annual shareholders meeting this year.

The publisher, Arthur O. Sulzberger Jr., came up with a solution, to have the executive editor handle complaints. On June 7, Accuracy in Media faxed a letter to the executive editor, Joseph Lelyveld, asking that he correct the assertion in a front-page story that the 1986 accident at Chernobyl had caused "untold thousands of deaths and illnesses." The letter said the total number of deaths attributable to the accident was only 48, according to the report of a 1996 international conference in Vienna.

This conference was sponsored by the World Health Organization, the European Commission, the International Atomic Energy Agency and other international bodies to have the foremost experts discuss what was known about the Chernobyl accident's consequences. It found that the only significant increase in cancer in the general population was in treatable thyroid cancer in children under fifteen years of age at the time of the accident. This accounted for three of the forty-eight deaths. On June 6, a report by the U.N. Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), covering developments since 1996, said that finding was still valid.

Irvine continues on page 70

Do the Laws of Nature and Physics Agree About What is Allowed and Forbidden?

Mario Rabinowitz*

Abstract

There are countless examples in the history of science that not only were the laws of physics often incomplete and more limited in their domain of validity than was realized, but at times they missed the mark completely. Despite this, our collective memory is often short on such matters, focusing on present triumphs and quickly forgetting past failures. This makes us less tolerant to that which challenges present orthodoxy. It may be of value to recall such past deficiencies as well as present shortcomings, particularly since science may always be encumbered with such limitations. We can avoid serious pitfalls if we let the past serve as a guide to the future. Subjects covered will include Gödel's theorem, superconductivity, zero-point energy, the quantum and classical Aharonov-Bohm and similar effects, theories of general relativity, Mach's principle, black hole radiation, ball lightning, and the universe(s).

Prologue

On October 9, 1992, I gave an extemporaneous lecture to physics teachers and students on the topic "Do the Laws of Nature and Physics Agree on What is Allowed and Forbidden?" at Virginia Commonwealth University in Richmond, Virginia. Editors of *21st Century Science and Technology* taped and transcribed my talk. They sent me the transcription and asked to publish a much-shortened version to meet space requirements of their magazine. The present paper utilizes some of the one-third material that was published in the Spring 1993 edition of *21st Century Science and Technology*, some of the two-thirds that wasn't used, and some new material. Some of the subjects not included from the previous article are the solar neutrino problem, quantum and classical tunneling, and the nuclear electromagnetic pulse. Thus, a slightly changed title seems appropriate.

Introduction

Both evolutionary and revolutionary corrections or changes are needed as physics progresses. I will touch upon clear-cut examples or paradigms of both kinds of corrections. They are indicative of the way that physical laws evolve when discrepancies are found with the prevailing view, and how they can be resolved. Sometimes the resolution is that the domain of validity is more limited than we originally thought. Newton's laws being a special case of Einstein's theory of special relativity for low velocities is an example of this. Many changes are abrupt, but we forget very quickly all the things that were wrong and how different they were from the things we now think. Corrections or changes usually rectify existing discrepancies, but as we shall next see, a more fundamental dilemma may always exist.

To me, physics strives to be a logical system like mathematics, with one more requirement that other logical systems don't have. That additional requirement is an isomorphism with physical reality—a one-to-one correspondence between the elements in the system and what we call the real world. Physical reality may not be the same to everyone, but we'll just sidestep that issue for now.

I'd like to tell you a little bit about Gödel's theorem and as a prelude to that, it is valuable to know the milieu in which Gödel developed this theorem. In Euclidean geometry, one of the axioms is the parallel line axiom, which basically says that parallel lines extended to infinity remain the same distance apart. Their separation doesn't diverge or converge. An age-old question for mathematicians is: Can we pare down the number of axioms that we need for a given system? It was very strongly felt that one should be able to derive the parallel line axiom. It didn't appear to be needed as an axiom for the system. Some of the best mathematical minds tried and were unable to do it by what is called a constructive proof, that is, by a direct derivation.

Then they thought, "Well, if we can't prove it constructively, it may be much easier to do a non-constructive proof, i.e. by *reductio ad absurdum*." If there is a dichotomy and something is either A or B, then if one assumes that it's A and that leads to an absurdity or contradiction, the conclusion is that it must be B. It can only be A or B and it has been shown that it can't be A. So, independently, they assumed the opposite. Whether they assumed that the lines get closer together as they went to infinity, or that they diverge, a contradiction was never reached. Theorems were never derived that were self-contradictory. So the possibility of convergence or divergence of parallel lines was never disproved. Thus, Nicolai Lobachevski in 1829, Janos Bolyai in 1832, Bernard Riemann in 1854, and even Karl Gauss in 1792 independently discovered non-Euclidean geometries. However, Gauss didn't publish his papers on this subject, keeping them locked up, because he thought there would be too much controversy.

That's one of the conundrums that occurred before Gödel's theorem. Furthermore, Alfred North Whitehead and Bertrand Russell felt that mathematics had grown so big and so disparate that it would be nice to bring it all together on a single unified basis. Just as we'd like to have a unified field theory in physics (the unified equations that describe all of nature), they wanted to unify mathematics on a sound basis starting with a given set of axioms and, by deduction, derive everything. They finished their book, *Principia Mathematica*, in 1925. Although they may not have completed the whole task, they did an admirable job.

Not long after, a young upstart threw a monkey wrench into the whole thing. This was Kurt Gödel, a twenty-four year old mathematician who in 1931 published the paper "On Formally Undecidable Propositions of *Principia Mathematica* and Related Systems." He restricted himself, basically, to arithmetic systems and showed that there were two things that you could never decide about the set of axioms. One was the question of *consistency*: Are your axioms self-consistent? Could you possibly have two or more axioms that were not explicitly inconsistent, but eventually, by no errors in logic, could lead to two theorems that are contradictory?

The second one is the question of *completeness*: Do you really have all the axioms that you need to answer all the relevant questions in the system? If the system is incomplete,

not all statements about the system can be proven to be true or false. Gödel found that you could not decide either question in advance.

A Talk with Gödel

This young insurgent was twenty-four years old when he wrote that paper. I was a twenty-four year old graduate student in physics when I read it, and was very impressed by it. I felt then, as I do now, that it also applies to physics. So as a young Ph.D. at the Westinghouse Research Center, I really looked forward to an assignment to go to Princeton to do some things on the Stellarator (controlled fusion reactor), because that might give me a chance to speak to Gödel. I did speak with Gödel and the bottom line of our discussion is that either through modesty on his part—he was very modest and very courteous—or to play devil's advocate, he took the position that Gödel's theorem does not apply to physics. I took the position that it does. He was very interested in hearing what I had to say. I didn't realize how lucky I was at the time, or I would have taken notes and written it down. We talked for at least an hour, maybe more, and it wasn't Gödel who finally ended the conversation.

Incidentally, Gödel and Einstein were friends, and he knew physics well. He solved Einstein's equations of general relativity for what is called the Gödel universe.

Superconductivity

Superconductivity falls into the realm of something that was contradictory to the laws of physics of the day. Superconductivity was not anticipated—no one ever predicted superconductivity. It was found by serendipity in an experiment and is a good example of experiment guiding theory. The inverse is also frequent. Superconductivity was discovered in 1911 by Kamerlingh Onnes. Prior to 1911, theoreticians speculated on three possibilities for conductors: 1) As the temperature approaches absolute zero, the electrons freeze out and the resistivity goes to infinity. 2) The phonons freeze out, and the resistivity approaches zero as the temperature approaches absolute zero. (The Nernst heat theorem says that you can never reach absolute zero.) 3) The lattice defects dominate, and the resistivity approaches some small, residual value, and doesn't keep on decreasing as the temperature is further lowered.

Onnes was one of the few who could go down to low enough temperatures to test these three possibilities, as he and Dewar had independently liquefied helium. Onnes chose mercury as the conductor because he wanted to purify it. Mercury has a high vapor pressure—it's easily distilled and, hence, easily purified compared to other materials. It was really fortuitous that he chose a poor conductor like mercury. If he had the means of purifying copper, or silver, or gold, which are good conductors, which you'd think would be a better thing to use for asking these kinds of questions, he'd never have discovered superconductivity.

Those materials that are poor normal conductors become superconductors, because for the metallics, where you have phonon-coupling to pair electrons, you need a strong phonon interaction. However, a strong phonon interaction gives you a high resistivity material. So, luckily, he chose mercury and, lo and behold, at about 4.2 degrees Kelvin (K), mercury lost all resistivity and became superconducting. He couldn't believe it! Finally after checking and double-checking, he convinced himself that he had made a true discovery.

Superconductivity is an example where there wasn't just

an evolution of a field, but a revolution because nature turned out to be much different than expected. Even though most scientists thought that high- T_c (transition temperature, or critical temperature) superconductivity was highly unlikely, it should be considered only evolutionary because it is an extension of what was already known. In the 1970s, a decade before Bednorz and Mueller's discovery, many experimental observations of high- T_c superconductivity were basically dismissed by the scientific community because it was hard to reproduce the results. Even to this day, there are many unreproducible observations of what you might call super-high-temperature superconductivity above 200°K.

It has been said that all of mathematics is a tautology. Some would even go so far as to say all of physics is a tautology. You can't quite say that for physics. Even if physics were to try to be a tautology, I don't think it would succeed, and it's because of experimental discovery. What is meant by a tautology is that everything is in your initial axioms and postulates. Now, one may not be smart enough to see that it's all there, but it is all there. Enlightenment results from the exposition. You're just making explicit what is implicit. So, I try to find the source that leads to major conclusions in theories.

Where in the Bardeen-Cooper-Schrieffer (BCS) theory does the superconductivity come from? It's put in, where the electron pairs are assumed to have equal and opposite momenta so that when one of the electrons scatters, the other electron is required to scatter in an equal and opposite direction. Thus the center-of-mass of the pair just keeps on moving along, as if there had been no scattering. Of course, there's a lot more to it than that.

I have really enjoyed reading James Clerk Maxwell. He was very interested in the viscosity of gases. I think he's one of the most honest scientists that I've read. He pointed out his own mistakes and gave due credit, in saying something like "that's wrong in the previous paper I wrote, and Professor Clausius got it right." He was one of the few theoreticians in the old days who paid attention to experiments and often quoted recent results, and where they agreed and disagreed with his theory. To predict viscosity was a tough problem. Reading Maxwell's thoughts on the viscous free gas reminded me of BCS and the equal and opposite momenta of an electron pair.

To my knowledge, the transition temperature has rarely been predicted before it was measured. Ordinarily it is not possible to calculate the transition temperature T_c of superconductors without knowing the interaction that leads to electron (Cooper) pairing. This is difficult to do even when the mechanism is known because of the exponential dependence on the density of states in the BCS theory. Based upon a pairing attraction caused by phonon exchange, T_c calculations give satisfactory agreement with experiment for monatomic metals and for some ordered alloys. However, they are inapplicable to materials such as the cuprates that are beyond the typical parameter range.

A Simple Theory of Superconductivity

For conventional superconductors, the detailed calculation of the electron-phonon spectral density and subsequent solution for T_c of the Eliashberg equations is time-consuming, laborious, and costly. This is the case even for relatively simple materials. Correct transition temperatures can't even be calculated for the more complex high- T_c materials.

Consequently, simple T_c formulas, even if they are only approximate or only provide bounds, would be of great

value in the search for more practical superconductors and in the pursuit of a more comprehensive theory of superconductivity. It is in this spirit that I developed a theory in 1987 that is probably the world's simplest and most general theory for calculating T_c . It applies to and works reasonably well for every class of superconductors and their pressure dependence, as well as superfluids.

I was led to this theory by the following considerations. Two conditions are met by known superconductors. One is the existence of bosons (integer spin particles). The other is a quantum condensation in phase space; that is, populating of the ground state on a macroscopic scale. This led me to the concept that there may be two temperatures: T_p , the pairing temperature to form bosons (integer spin particles) by pairing fermions (half-integer spin particles); and T_{cond} , the condensation temperature for pairs. In accord with my concept, recent experiments indicate that the cuprates become paired at high temperatures, and then become superconducting with a decrease in temperature.

If the pairing temperature is less than the condensation temperature, then the pairing temperature is T_c , the limiting temperature for superconductivity. This is because quantum condensation cannot occur before there are pairs, i.e. bosons. However, if pairing occurs before condensation, i.e. at a higher temperature, then it should be possible to calculate T_{cond} without knowledge of the pairing mechanism. This is because the pairs (bosons) are there waiting for a low enough temperature to condense, and then $T_{\text{cond}} = T_c$. The BCS theory essentially calculates T_p . The reason that the BCS theory is successful is that $T_p < T_c$, because metallic conductors have a high number density of electrons.

The transition temperature¹ for a three-dimensional superconductor or superfluid is:

$$T_{c3} = 2.77 \times 10^{-3} \left[\frac{h^2 n^{2/3}}{m k g^2} \right] = 2.28 \times 10^{-2} \left(\frac{T_F^{3D}}{g^2} \right). \quad (1)$$

For a two dimensional superconductor such as the high- T_c cuprates, it is:

$$T_{c2} = \frac{3}{2} T_{c3} = 4.15 \times 10^{-3} \left[\frac{h^2 n^{2/3}}{m k g^2} \right] = 5.22 \times 10^{-2} \left[\frac{T_F^{2D}}{n^{1/2} g^2} \right] = 3.42 \times 10^{-2} \left(\frac{T_F^{2D}}{g^2} \right). \quad (2)$$

where h is Planck's constant, k is the Boltzmann constant, n is the number density of free electrons (or carriers), m is the effective mass of the electrons in the given material, $g=1$ if the pair is a boson of zero spin, and $g=3$ if the pair is a boson of spin = 1. The average spacing between planes is δ . T_F^{2D} is the two-dimensional Fermi temperature which is related to T_F^{3D} , the three-dimensional Fermi temperature. My theory is the only one that simply relates T_c to the experimental Fermi temperature.

Equations 1 and 2 work well for superfluids and all known classes of superconductors (except the metallics) such as heavy electron metals, cuprates, and layered organics, as well as making reasonable predictions for hydrides, metallic hydrogen, and neutron stars. They don't work well for metallic conductors such as Cu, Ag, and Au because $T_c > T_p$ for these high electron number density materials. Nevertheless, it is noteworthy that my theory works so well with no arbitrary parameters, such simplicity, and for the entire range of superconductors. The input comes from experimentally determined parameters. Table 1 includes predictions for the heavy fermion, cuprate, organic, bismuth

oxide, and dichalcogenide superconductors for which other theories cannot even calculate T_c .¹ Furthermore, as shown, the same simple equations make accurate calculations for superfluids He³ and He⁴. No other theory even attempts both superfluids and superconductors with the same equation.

Pressure Dependence of T_c

To show the generality of my theory, let us see the excellent predictions it makes for the pressure dependence of the critical temperature, T_{cp} . To illustrate the clarity and crispness of this approach, it takes just several steps to derive T_{cp} . The basic idea is that compression of the superconducting material compresses the free electron volume, increasing the electron number density.² We can write Equations 1 and 2 as one general equation

$$T_c = A \left[\frac{h^2 n^{2/3}}{2 m k} \right], \quad (3)$$

where $A = A_3 = 0.218$ for isotropic 3-D SC and $A_2 = (3/2)A_3 = 0.328$ for anisotropic 2-D SC, h is (Planck's constant)/ 2π , m is the electron (carrier) effective mass, and k is the Boltzmann constant. The number density of electrons is $n = N/V$, where N is the number of electrons and V is the volume of the sample.

Equation 3 implies

$$\frac{T_{cp}}{T_c} = \left(\frac{N_p}{N_o} \right)^{2/3} \left(\frac{m_o}{m_p} \right) \left(\frac{V_o}{V_p} \right)^{2/3}. \quad (4)$$

The inverse of the bulk modulus is the compressibility

$$\kappa = -\frac{1}{V} \frac{\partial V}{\partial P}. \quad (5)$$

Integrating Equation 5, we obtain

$$\left(\frac{V_o}{V_p} \right) = e^{\kappa' \Delta P}, \quad (6)$$

where κ' is the average compressibility over the range ΔP from 0 to P . Substituting Equation 6 into Equation 3

$$\left(\frac{T_{cp}}{T_c} \right) = e^{\frac{2}{3} \kappa' \Delta P} \left(\frac{N_p}{N_o} \right)^{2/3} \left(\frac{m_o}{m_p} \right). \quad (7)$$

In so far as $\left(\frac{N_p}{N_o} \right), \left(\frac{m_o}{m_p} \right), \left(\frac{\kappa'}{\kappa} \right)$ are ≈ 1 , then

$$T_{cp}^{\text{theo}} = T_c^{\text{exp}} e^{\frac{2}{3} \kappa \Delta P} = T_c^{\text{exp}} \left(1 + \frac{2}{3} \kappa \Delta P \right), \quad (8)$$

where T_{cp}^{theo} is the maximum transition temperature attainable by applying the pressure differential ΔP , and T_c^{exp} is the experimental transition temperature at atmospheric pressure.

Table 2 shows the excellent agreement Equation 8 gives for a variety of high- T_c superconductors for very high pressures. This is quite an achievement, as to my knowledge there is no other equation or algorithm for doing this.

The Meissner and Anti-Meissner Effect

It was not until 1933, twenty-two years after the discovery of superconductivity, that the Meissner effect was discovered. From Maxwell's equations you expect the field to be frozen-in during transition from the normal to the superconducting states rather than expelled. It was not because it was a hard experiment to do, but many people just didn't

think it was worth doing. So people thought for those twenty-two years that the Meissner effect was impossible. Then, after the Meissner effect became entrenched, they thought that the anti-Meissner effect was impossible. I and my colleagues at Stanford University decided there could be a virtual violation of the Meissner effect, *i.e.* trapping instead of expelling the field. Thus, when we submitted our magnetic flux trapping papers for publication in 1973, the referees responded that this shouldn't be published and made reference to books that said this was impossible. My answer was, "Ours isn't a theoretical paper, it's an experimental paper. We've done it." It just shows how things become entrenched.

To produce a precise field with an electromagnet or a permanent magnet you have to go to great pains. With an electromagnet you need to wind it very accurately. The physical geometry of a permanent magnet has to be carefully machined. Once you have your first pattern magnet, you can walk in with some glob of superconductor, stick it in the magnet—it has its own smarts built into it—trap the field,

and walk off with it. Not only do you have a large field, but you've got a field with very high fidelity to the original field and not just simply uniform fields, but dipoles, quadrupoles, etc. You name it. If you can make it, a superconductor can trap it.³

Vacuum Zero-Point Energy

The vacuum zero-point energy problem challenges the very core of physics. It makes quantum physics look bad, and even challenges classical physics. Timothy Boyer has shown that zero-point energy may equally well be regarded as a classical phenomenon.⁴ It is a very serious problem that has been around since the 1930s, to which no satisfactory solution has been offered. I have an idea that helps to resolve it, but first let us see what the problem is.

Aristotle wrote that nature abhors a vacuum, and modern zero-point energy physics seconds this notion in which a vacuum teams with not only field energy fluctuations, but with particle-antiparticle pairs that spontaneously pop in and out of existence. As fantastic as this may sound, it does lead to detectable effects like the Lamb shift of atomic energy

Table 1. Wide Range of Experimental and Theoretical Transition Temperatures

No.	Superconductor-fluid	T_c^{exp} (K)	T_c^{pred} (K)	T_F^{2D} (K)	n ($10^{21}/\text{cm}^3$)	$\delta(\text{\AA})$	T_F^{3D} (K)
1	^3He in ^4He	?	10^{-6} - 10^{-5}	-	-	-	-
2	H	?	30×10^{-6}	-	10^{-7}	-	-
3	^3He	0.0025	0.0028	-	23.6	-	-
4	^4He	2.17	3	-	22	-	-
5	UPt_3	0.53	0.68, 0.71, 0.74	-	-	-	124±5
6	$[\text{TMTSF}]_2\text{ClO}_4$	1.2	2.31, 3.91, 6.35	72±24	0.38 ± 0.17	13.275	-
7	$\text{TaS}_2(\text{Py})_{1/2}$	3.4	2.61, 3.60, 4.92	1710±360	12 ± 3.6	12.02	-
8	PbMo_6S_8 (Chevrel)	12	7.38, 9.54, 11.68	-	-	-	1640±370
9	$\kappa\text{-}[\text{BEDT-TTF}]_2\text{Cu}[\text{NCS}]_2$	10.5	7.26, 10.8, 15.3	213±57	0.31 ± 0.09	15.24	-
10	$\text{BaPb}_{0.75}\text{Bi}_{0.25}\text{O}_3$	11	11.4, 12.4, 13.4	-	-	-	242±20
11	$\text{Ba}_{0.6}\text{K}_{0.4}\text{BiO}_3$	32	55.9, 62.1, 68.3	-	-	-	1210±120
12	$\text{La}_{1.9}\text{Sr}_{0.1}\text{CuO}_4$	33	45.8, 50.8, 55.8	510±50	~0.5	6.61	-
13	$\text{La}_{1.875}\text{Sr}_{0.125}\text{CuO}_4$	36	33.4, 56.2, 61.7	710±7	~1.0	6.61	-
14	$\text{La}_{1.85}\text{Sr}_{0.15}\text{CuO}_4$	39	43.0, 49.7, 57.3	1090±100	5.2 ± 0.8	6.62	-
15	$\text{YBa}_2\text{Cu}_3\text{O}_{6.67}$	60	49.8, 61.3, 79.4	710±70	1.1 ± 0.4	5.87	-
16	$\text{YBa}_2\text{Cu}_4\text{O}_8$	80	64.3, 74.1, 87.8	1360±140	2.8 ± 0.44	6.81	-
17	$\text{YBa}_2\text{Cu}_3\text{O}_7$	92	71.8, 79.9, 89.9	2290±100	16.9 ± 3.4	5.84	-
18	$\text{HoBa}_2\text{Cu}_4\text{O}_8$	80	131, 145, 159	2070±200	~1.3	6.82	-
19	$\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_8$	89	37.6, 43.2, 77.1	970±390	3.5 ± 1.8	7.73	-
20	$(\text{Tl}_{0.5}\text{Pb}_{0.5})\text{Sr}_2\text{CaCu}_2\text{O}_7$	80	75.5, 89.6, 103	1440±140	2.8 ± 0.5	6.05	-
21	$\text{Tl}_2\text{Ba}_2\text{CaCu}_2\text{O}_8$	99	41.0, 49.6, 61.2	1180±110	4.9 ± 1.5	7.33	-

Where three numbers are shown for T_c^{pred} , these are the minimum, the mean, and the maximum predicted transition temperatures obtainable from the data as explained in ref. 1. The mean value does not always lie symmetrically between the minimum and maximum values.

levels and the Casimir effect that are found to agree with theory to high accuracy. But this comes with a high price to pay. Though most of the effects are finite, the calculated total zero-point energy is infinite.

This infinity can be reduced to a finite energy, by somewhat arbitrary theoretical cut-offs such as not allowing wavelengths shorter than the Planck length (10^{-33} cm). This is inconsistent with special relativity, as wavelength is a function of the observer's frame of reference. Nevertheless, it is done—but only with hollow success. Another approach relates to the standard model of fundamental particles. In these approaches, the resulting energy is finite, but is between 10^{46} to 10^{120} times too large.

The Cosmological Constant (CC) of General Relativity is proportional to the energy density of the vacuum. With the above exceptionally large vacuum energy, depending on the sign of the Cosmological Constant (CC), according to General Relativity the universe would have to be much smaller (-CC) or larger (+CC) than it is.

There is a problem even without a Cosmological Constant, as such an enormous energy would give the universe a strong positive curvature—contrary to observations of a flat universe.

I am aware that when all matter and heat radiation have been removed from a region of space, even classically there still remains a pattern of zero-point electromagnetic field energy throughout the space. Nevertheless, as an interesting exercise let us see how much of the discrepancy can be reduced if we assume that the vacuum zero-point energy is only associated with matter, *i.e.* it only exists in the vicinity of matter due to a rapid attenuation of fields. In contrast to the prevailing view, in my speculative hypothesis this energy would be limited to the region of space near matter and there would only be negligible vacuum zero-point energy in the vast regions of space where there is no matter. If the volume of matter in the universe is mainly nucleons, we can easily estimate the reduction:

Table 2. Comparing Experimental and Theoretical Values of Pressure-Induced T_c .

Compound	T_c^{exp} (K)	T_{cP}^{exp} (K)	T_{cP}^{theo} (K)	$\kappa \cdot 10^{-3} \text{ (GPa)}^{-1}$	ΔP (GPa)
1. HgBa ₂ Ca ₂ Cu ₃ O _{8+δ}	135	164	166	10	31
2. HgBa ₂ CaCa ₂ O _{8+δ}	128	154	157	10.6	29
3. HgBa ₂ CuO _{8+δ}	94	118	113	11.4	24
4. Bi _{1.68} Pb _{0.32} Ca _{1.85} Sr _{1.75} Cu _{2.65} O ₁₀	111	119	120	14.7	8
5. Tl ₂ Ba ₂ CaCu ₂ O ₈	109	119	111	7.3	3
6. YBa ₂ Cu ₃ O _{7.δ}	92	95	94.1	6.7	5
7. YBa ₂ Cu ₃ O _{7.δ}	90	93	93.7	6.7	9
8. Y _{0.9} Ca _{0.1} Ba ₂ Cu ₄ O ₈	90	98	92.7	≈ 9	5
9. YBa ₂ Cu ₄ O ₈	80	101	83.2	8.5	7
10. YBa ₂ Cu ₄ O ₈	80	106	84.7	8.5	10
11. CaBaLaCu ₃ O _{6.85}	62	86	64.8	8.2	8
12. La _{1.85} Sr _{0.15} CuO ₄	36	41	36.8	6.9	4.5
13. La _{1.85} Sr _{0.15} CuO ₄	36	41	36.7	6.79	4
14. La _{1.8} Ba _{0.2} CuO ₄	36	44	36.1	≈ 5.3	1.1
15. Nd _{1.32} Sr _{0.41} Ce _{0.27} CuO _{3.96}	24	46	>24.9	7.01	>8

This is a compilation of superconductors for which sufficient data could be obtained to calculate the maximum pressure-induced transition temperature T_{cP}^{theo} from the experimental atmospheric pressure transition temperature T_c^{exp} , in the pressure excursion ΔP , using only the compressibility κ as explained in ref.2. The calculated values T_{cP}^{theo} are compared with the experimental values T_{cP}^{exp} .

$$\frac{V_{\text{Universe}}}{V_{\text{TotalNucleons}}} \sim \frac{10^{79} \text{ m}^3}{\left(\frac{M_{\text{Universe}}}{M_{\text{Nucleon}}}\right) V_{\text{Nucleon}}} \sim \frac{10^{79} \text{ m}^3}{\left(\frac{10^{53} \text{ kg}}{10^{-27} \text{ kg}}\right) 10^{-45} \text{ m}^3} = 10^{44}. \quad (9)$$

Thus the vacuum zero-point energy can be reduced to between $10^{46-44} = 10^2$ and $10^{120-44} = 10^{76}$ times too large if this premise has merit. At the low end, the discrepancy is almost resolved, but at the high end it is still unacceptably large. The discrepancy can be further reduced by including the free space within nucleons which are made of quarks. This divergence between experience and theory is perhaps the most bewildering problem in physics, whose resolution may lead to far-reaching consequences of our view of nature.

General Relativity

Einstein's General Relativity

Einstein's General Relativity⁵ (EGR) is one of the most profound creations of the human mind. But, EGR is a non-linear theory that becomes highly non-linear inside a black hole, resulting in a singularity. EGR not only predicts black holes, but also predicts that the mass inside the black hole will inevitably shrink down to a point, resulting in infinities of mass density, energy density, etc. Such singularities and other more subtle effects are indicative that at least in this regime EGR may be inconsistent with nature. This is similar to the breakdown of continuum hydrodynamics when length scales comparable to atomic diameters are considered.

In EGR all fields, except the gravitational field, produce space-time curvature, since the gravitational field is but a consequence of the curvature of space-time. Einstein reasoned that since curvature produced gravity, curvature cannot change gravity, *i.e.* make more or less gravity. To Einstein this would be double counting. The argument becomes less clear when inverted: Gravity cannot change curvature. This prohibition in EGR ultimately leads to black holes, in which singularities are the most egregious difficulties.

Yilmaz' General Relativity

Hüseyin Yilmaz⁶ made an interesting variation of EGR which avoids not only the singularities but the black holes altogether. He assumed that gravitation field energy also produces curvature of space-time by adding a "gravitational stress-energy tensor" to Einstein's equations. Since this term is relatively small in the three major tests of EGR, Yilmaz' General Relativity (YGR) makes essentially the same predictions as EGR for the advance of the perihelion of mercury, gravitational red shift, and the bending of starlight (the least accurately measured of the three tests). EGR and YGR cannot both satisfy the equivalence principle of GR—at least not in its strong form. The Misner, Thorne, and Wheeler tome⁷ and other texts cover many competing theories of gravitation and point out their shortcomings, but they seem not to have discussed or referenced Yilmaz' general relativity.

It may not be obvious why including gravitational field energy as a source of space curvature eliminates black holes. Here is a simple intuitive way to understand this. The static field and the near field (induction field) of a time-varying gravitational field have negative energy. (This can be tricky since the electrostatic field energy is positive. The radiation field has positive energy for both fields.) Negative energy gives negative curvature tending to cancel the positive curvature due to mass. Instead of black holes, YGR has grey holes where the emitted light is greatly red-shifted. If neu-

tron stars with mass much greater than 3 solar masses, or white dwarfs with mass much smaller than 1.4 solar masses, were detected, this would favor YGR over EGR.

Despite much effort, no one has yet solved the two-body problem in Einstein's General Relativity. Yilmaz and his colleagues would say that they never will since it is their view that EGR is a one-body theory in which one body (*e.g.* the Sun) establishes a space-time curvature (field) which determines the motion of a test body (*e.g.* Mercury) that hardly perturbs the established field. YGR claims to be an N-body theory. Yilmaz says that if one takes the weak field limit of EGR and considers a many body problem like the perturbation effects of planetary orbits on each other, EGR doesn't work. He asserts that the weak field limit of YGR gives exactly the same results as Newtonian gravity, including perturbation effects. Another point in favor of Yilmaz is that in particle physics, energy is ascribed to the gravitational field.

I have mixed emotions and biases to overcome with respect to the absence of black holes in both YGR and Dicke's polarizable vacuum (ether) theory of gravitation. I certainly like the absence of singularities in these theories and they intrigue me. Until recently, I never had any reason to doubt the soundness of EGR. I did worry about black hole "no hair" theorems that appeared easily vulnerable to violation by the presence of other bodies. Misner⁸ has challenged Yilmaz' formulation with rebuttal⁹ by Alley and Yilmaz. At this point there is only a fracas. Whether it will develop into a full-fledged battle or remain a minor skirmish remains to be seen. If properly and fairly conducted, this is a healthy thing for physics, for honest dissension is a major mode by which physics progresses and comes into closer agreement with nature.

With respect to the 43" per century advance of the perihelion of Mercury predicted by both EGR and YGR, a special tribute is owed to astronomers as well as an accolade to Newtonian gravity which applies for the ordinary gravitational fields encountered in our solar system. It is not well known that the total perihelion advance of Mercury's orbit around the Sun is 575" per century of which 532" is due to the other planets as calculated by astronomers using Newtonian gravity. Paul Gerber¹⁰ effectively calculated 41"/century advance of the perihelion of mercury seventeen years before EGR using a retarded gravitational potential rather than Newton's instantaneous propagation of gravity. He calculated the speed at which gravity is propagated and got 3.055×10^8 m/sec, a speed slightly greater than today's speed of light, $c = 2.998 \times 10^8$ m/sec. He would have gotten 42"/century if he had used c . I would love to scrutinize his analysis in detail, but my ability to read German has gotten too rusty. I would be grateful for an English translation.

Dicke's General Relativity

Robert H. Dicke¹¹ developed a polarizable vacuum (ether) representation of General Relativity in which there is no space-time curvature. It derives gravitation as a manifestation of electromagnetism and would thus be a giant step forward toward a unified field theory if it were correct. It considers the implications of a greater ether density in the vicinity of a gravitating body. In his theory a body falls toward regions of greater gravitational field because the charged particles of which the body is composed move to the region of space where the dielectric constant of the ether is greater. Although Dicke's general relativity (DGR) has an entirely different basis than that of Yilmaz, the metric that Dicke

obtains is precisely the same as Yilmaz. Hence, it also has no black holes, and makes the same predictions for the three major experimental tests of GR. For all three approaches—EGR, YGR, and DGR—a light wave generates twice the gravitational field per unit energy density, giving twice the deflection of a light ray than expected from Newtonian gravity.

As with YGR, DGR seems to have been totally neglected by the major chroniclers of GR, such as Misner, Thorne, Wheeler, and other texts. However, Dicke and his student Carl Brans' new theory fared better, and was considered a major challenge to EGR for a while. It was motivated to clearly comply with Mach's principle. In the Brans-Dicke¹¹ GR (BDGR) theory, masses throughout the universe generate a scalar potential field, in addition to Einstein's curvature of spacetime, which can influence the strength of the universal gravitational constant G in space or time, since G is linked to the matter-energy distribution of the universe. Whenever the scalar field is high, G is low. Dicke led theoretical and experimental challenges to GR. At the same time that he was promoting BDGR, he helped with experiments that brought about its downfall, and bolstered EGR. It is not clear what bearing these experiments had on YGR.

Mach's Principle

Local determination of an inertial frame can be made by observing a stationary bucket of water with a flat surface versus a concave parabolic surface for a non-inertial rotating pail, or by a Foucault pendulum. (A bucket of superfluid helium has its own surprises.¹³) Global determination of an inertial frame can be made by observation of a frame relative to the distant fixed stars, *i.e.* the rest of the universe. It is remarkable that both methods give the same result. Mach was the first to conclude that this agreement implies that the distant stars determine the local inertial frame of reference since the local frame cannot conceivably affect the distant stars. Mach had trouble publishing his principle in the scientific journals of his day, so he included it in his 1912 book, *The Science of Mechanics*.¹⁴

Einstein was impressed that the distant stars have an influence on the local properties of matter, and tried to incorporate Mach's principle into GR, but succeeded in only a limited sense. GR does include Mach's principle in some special cases.¹⁵ But this comes with some problems of its own. In EGR it is hard to see how those distant stars can impose their choice of which frames are inertial and which accelerating with sufficient alacrity to affect rapidly changing frames, if the frame information is limited to propagate at the speed of light. Aside from this problem, with respect to the rotating bucket, EGR does suggest that if the bucket is at rest and the distant stars rotate around it, its surface will be parabolic as if it were rotating. The BDGR theory was an attempt to better incorporate Mach's principle than does EGR.

Black or Grey Hole Radiation

Occasionally theories become established without a good foundation of supporting experiments. They become part of the lore of physics and are difficult to displace by a competing theory. Until the old theory is proven wrong by experiment, new paradigms are considered wrong by definition since they predict results which differ from those of the established, hence "correct" theory. This has been the case for Hawking's seniority model of black hole radiation which has been theoretically but not experimentally established.

If YGR is correct and there are no black holes, this

impinges more on Hawking's model of black hole radiation than it does on my field emission-like model of gravitational tunneling radiation.¹⁶⁻¹⁹ Tunneling radiation would still be nearly the same between a very dense little grey hole and a second body.

Belinski,²⁰ a noted authority in the field of general relativity, unequivocally concludes "the effect [Hawking radiation] does not exist." He argues against Hawking radiation due to the infinite frequency of wave modes at the black hole horizon, and that the effect is merely an artifact resulting from an inadequate treatment of singularities.

The fact that a derivation is invalid does not disprove the existence of the effect. Belinski probes deeper than this by setting up the problem with what in his terms are proper finite wave modes. He then concludes that no particle creation can occur. The Rabinowitz radiation tunneling model¹⁶⁻¹⁹ involves no infinite frequency wave modes, and particle-antiparticle pairs do not have to be created.

Hawking takes the position that radiation does not originate from within a black hole, but comes from the vicinity outside it, only appearing to come from within. Hawking concludes that the information that entered the black hole can be forever lost. If Hawking radiation does not come from within the hole (but only appears to) then it does not really reflect what is inside as the hole evaporates away. This is further exacerbated in that for him the radiation is black body radiation, which loses information about its source.

On the other hand, time-reversal symmetry, energy conservation, and classical and quantum physics are violated if the information is lost. Gravitational tunneling radiation¹⁶⁻¹⁹ resolves this enigma, since it comes from within the hole and carries attenuated but undistorted information from within. Since it is a tunneling process and not an information voiding Planckian black body radiation distribution, it can carry information related to the formation of a black hole, and avoid the information paradox associated with Hawking radiation.

Parikh and Wilczek²¹ take a black hole radiation tunneling approach quite similar to mine, but didn't reference my work. For them, the second body which makes the potential barrier finite originates artificially from the black hole as a spherical shell. This seems a bit contrived to get a result similar to Hawking's with radiation in all directions. In my approach, the second body originates from outside the black hole and results in beamed radiation. Perhaps they didn't know about my papers, so I sent them copies.

Little Holes and the Incidence Rate of Ball Lightning

It took centuries before the orthodoxy of science accepted ball lightning (BL)—an experienced not theoretical phenomenon. It is my hypothesis that BL is a manifestation of cosmic little holes (LH). What follows helps to make a case for this. I've purposely left out the designation "black holes" or "grey holes" in the title of this section. The consequences of my analysis remain unchanged whether the holes are black or grey, so I will just call them "holes." In either case, they are candidates for the missing "dark" mass of the universe, and candidates as the cause of ball lightning and contributors to the accelerated expansion of the universe.

I will focus here on new analysis related to a prediction of the incidence rate of ball lightning not covered in my earlier work. The continuity equation for mass flow of LH when there is a creation rate S_c and a decay rate S_d of mass per unit volume per unit time t is

$$\nabla \cdot (\rho \vec{v}) + \partial \rho / \partial t = S_c - S_d, \quad (10)$$

where ρ is the LH mass density at a given point in the universe, $\vec{v}$ is the LH velocity, and $\rho \vec{v}$ is the LH flux density. In steady state, $\partial \rho / \partial t = 0$. Integrating Equation 10:

$$\int (\rho \vec{v}) \cdot d\vec{A} = \int (S_c - S_d) dV_t \Rightarrow -\rho_{LH} v_{LH} A_{far} + \rho_{BL} v_{BL} A_E = (S_c - S_d) V_t. \quad (11)$$

where ρ_{LH} is the mass density of LH at a distance far from the earth, typical of the average mass density of LH throughout the universe. A_{far} is the cross-sectional area of a curvilinear flux tube of LH far from the earth, A_E is the cross-sectional area of the tube where it ends at the earth, and V_t is the volume of the curvilinear flux tube (cylinder). Since the LH were created during the Big Bang at a large distance from the earth, they should be in the cosmic rest frame. The velocity of our local group of galaxies with respect to the microwave background (cosmic rest frame), $^{22}v_{LH} \sim 6.2 \times 10^5$ m/sec is a reasonable velocity for LH with respect to the earth.

Because v_{LH} is high and LH radiate little until they are near other masses, S_c can be neglected because of negligible decay of large black holes into LH in the volume V_t . Similarly, S_d may be expected to be small until LH are in the vicinity of the earth where most of their evaporation, before they are repelled away, is in a volume of the atmosphere $\sim A_E h$, where A_E is the cross-sectional area of the earth, and h is a characteristic height above the earth. At this point it is helpful to convert to number density ρ_L and ρ_B , of LH and ball lightning respectively. The number density decay rate is $\rho_B A_E h / t$, where $t < \sim$ year is the dwell-time of LH near the earth. Thus Equation 11 yields

$$\rho_B = \rho_L \left[\frac{v_{LH}}{v_{BL} + (h/\tau)} \right] \frac{A_{far}}{A_E}, \quad (12)$$

which implies that the ball lightning flux is

$$\rho_B v_{BL} = \rho_L v_{LH} \left[\frac{v_{BL}}{v_{BL} + (h/\tau)} \right] \frac{A_{far}}{A_E} \approx \rho_L v_{LH} \left(\frac{A_{far}}{A_E} \right), \quad (13)$$

where in most cases $h/t \ll v_{BL}$.

At large velocities, LH that do not slow down appreciably due to their large mass or angle of approach either do not produce sufficient ionization to be visible or do not spend sufficient time in the atmosphere to be observed. In the Rabinowitz model,^{16,18} those LH that reach the earth's atmosphere and are small enough to have sufficient radiation reaction force to slow them down to the range of 10^{-2} to 10^2 m/sec, with a typical value $v_{BL} \sim 1$ m/sec, manifest themselves as BL. So Equation 13 implies that the ball lightning current in the atmosphere $\approx$ the LH current far away. We can thus give a range for the BL flux density

$$\rho_L v_{LH} < \rho_B v_{BL} < \rho_L v_{LH} \left(\frac{A_{far}}{A_E} \right). \quad (14)$$

The distribution of LH masses is not known. Assuming that LH comprise all of the dark matter, i.e. 95 % of the mass of the universe¹⁶⁻¹⁸ of which there is a percentage p of LH of average mass $M_{LH} \sim 10^3$ kg

$$\rho_L \sim \frac{p(0.95 M_{univ} / M_{LH})}{V_{univ}}. \quad (15)$$

For $M_{univ} \sim 10^{53}$ kg, $V_{univ} \sim 10^{79}$ m³ (radius of 15×10^9 light-year = 1.4×10^{26} m), and $p \sim 10\%$, $\rho_L \sim 10^{-24}$ LH/m³. Thus from Equations 12 and 13 my model predicts that the incidence rate of BL is roughly in the range 10^{-12} km⁻² sec⁻¹ to $\gg 10^{-8}$ km⁻² sec⁻¹ for $A_{far}/A_E > \sim 10^4$. (Even if $p = 100\%$, 10^{-11} km⁻² sec⁻¹ is well below the signal level of existing detectors.) This rate is in accord with the estimates of Barry and Singer²³ of 3×10^{-11} km⁻² sec⁻¹, and of Smirnov²⁴ of 6.4×10^{-8} km⁻² sec⁻¹ to 10^{-6} km⁻² sec⁻¹.

The Quantum and Classical Aharonov-Bohm and Similar Effects

Aharonov-Bohm Effect

The question of which is more fundamental, force or potential energy—or equivalently, field or potential—is central to whether the laws of physics agree with the laws of nature. This is so even if it is decided that they are equal in importance. In Newtonian classical physics (NCP), force (*vis motrix* in Newton's *Principia*, 1686) and kinetic energy (originally called *vis viva* in Leibnitz' *Acta erud.*, 1695) are two of the foremost concepts. Although classically the concept of potential energy is a secondary concept for obtaining force and fields, its importance in the principle of the conservation of total energy cannot be overlooked. In quantum physics (QP), potential and kinetic energies are the primary concepts, with force hardly playing a role at all. One might incorrectly conclude: "No wonder then that effects were discovered early in the development of quantum physics that did not depend on forces at all." This was not the case, leaving aside the wave-particle duality, which is a horse of another color.²⁵

It was not until 1959, some thirty-three years after the advent of quantum physics, that Yakir Aharonov and David Bohm presented the first QP effect that was a radical departure from NCP. Aharonov and Bohm described gedanken electrostatic and magnetostatic cases in which physically measurable effects occur where no forces act.²⁶ This is now known as the Aharonov-Bohm (A-B) effect.

In the magnetic case, an electron beam is sent around both sides of a long shielded solenoid or toroid so that the electron paths encounter no magnetic field and hence no magnetic force. They encounter a magnetic vector potential, which enters into the electron canonical momentum producing a phase shift of the electron wavefunction, and hence QP interference. If the electrons go through a double slit and screen apparatus²⁵ the shielded magnetic field shifts the interference pattern periodically as a function of the flux quantum in the shielded region, and hence Planck's constant. This was confirmed experimentally and considered a triumph for QP, and appears not to have been seriously challenged for forty-one years.

I read the A-B paper as a graduate student when it first came out in 1959. I understood it. It impressed me with the power of quantum mechanics. I did try to think of classical electrodynamic ways to explain the effect. Lilienfeld transition radiation and simpler effects entered my mind, but I did not pursue them. To Feynman the wave-particle duality as embodied in the two-slit diffraction experiment contains the mystery of QP.²⁵ To me the magic of QP was embodied in the A-B effect. (In my black hole analysis, I showed that there is an

A-B effect for gravitational tunneling radiation.¹⁷⁾

To my surprise and delight, I recently came across two papers by Timothy Boyer in which he reasons that the A-B effect can be understood completely classically.^{27,28} (His approach is more direct than the one taken by Cohn and Rabinowitz²⁹ in developing a classical analog to quantum tunneling, which had also been thought to be completely QP.) First he points out that there has been no real experimental confirmation of the A-B effect. The periodic phase shift of a two-slit interference pattern due to a shielded magnetic field has indeed been confirmed. However, no experiment has shown that there are no forces on the electrons, that the electrons do not accelerate, and that the electrons on the two sides of a solenoid (or toroid) are not relatively displaced. Boyer then goes on to propose a classical mechanism that makes sense.

The charged particle (electron) induces a field in the conductor (shield or electromagnet, it doesn't seem to matter), and this field acts back on the charged particle producing a force which speeds up the particle as it approaches and then slows the particle as it recedes, so that it time averages to zero. This sequence is reversed on the other side of the magnetic source giving interference. The displaced charge in the shield (or solenoid windings) affects the current in the solenoid, and hence the center-of-energy of the solenoid field.

Boyer may not have tied all the loose ends together yet, but it is a promising start. With two thick superconducting shields—separated by a vacuum—surrounding a toroid, it is not clear how the electron classically senses the toroid's magnetic field, much less how Planck's constant h could enter into CP via the shielded magnetic flux. His explanation in terms of forces brings up problems with relativity; however, I think he is safe in considering the $v \ll c$ limit. Nevertheless his is the first real challenge to the A-B paradigm. At the very least, he has pointed out the way for the needed definitive experiments to decide whether or not the A-B effect can only be understood by QP.

Aharonov-Casher Effect

Aharonov-Casher (A-C) in 1984 discovered an analog of the A-B effect in which the electrons are replaced by magnetic dipoles such as neutrons, and the shielded magnetic flux is replaced by a shielded line charge. Although it is considered to be solely in the domain of QP by the orthodox physics community, Boyer previously proposed a classical interpretation of the A-C phase shift effect.^{27,28}

Berry's Geometric Phase

In 1984, the same year as the A-C effect, Michael V. Berry theoretically discovered that when an evolving quantum system returns to its original state, it has a memory of its motion in the geometric phase of its wavefunction. There are both quantum and classical examples of Berry's geometric phase (BGP), but as far as I know no one has yet challenged the QP case with a CP explanation. Yet it is noteworthy that in 1992 Aharonov and Stern³⁰ did the QP analog of Boyer's^{27,28} CP in analyzing BGP in terms of Lorentz-type and electric-type forces to show that BGP is analogous to the A-B effect.

Winterberg's Aether

Friedwardt Winterberg developed an aether model using positive and negative Planck masses which he claims can lead to the results of quantum physics and relativity, as well as explaining the vacuum zero-point energy anomaly dis-

cussed in Section 5. He asserts that there is a close relationship between the Sagnac and A-B effects, which can be understood from his model.³¹ For him, the A-B effect results from a cancellation of the kinetic energies of positive and negative mass vortices, much the same as the vanishing of the sum of positive and negative energies leading to $\sim$ zero for the zero-point vacuum energy. Winterberg's theory is based upon the interesting concept that by assuming a different fundamental structure, NCP is adequate to obtain QP and EGR.

Universe(s) According to Poe

Over the ages there have been many differing views of the universe varying from finite to infinite in extent and/or time. In ancient eastern cosmology, not only the world, but the entire universe is believed to recycle itself in never-ending cycles of birth, growth, death, and rebirth from its own ashes, much like a phoenix. When it comes to imagining the universe, Edgar Allan Poe at the age of thirty-nine (one year before his untimely death) was well ahead of his time. In his prescient science fiction writings he spoke of separate and distinct universes, each with its own set of laws—much as only recently imagined by modern physics.³² He writes:

"there does exist a *limitless* succession of Universes, more or less similar to that of which we have cognizance. . . it is abundantly clear that. . . they have no portion in our laws. . . Each exists apart and independently. . ."

In the preface to this book, Poe says that his book is for "the dreamers and those who put faith in dreams as the only realities." Poe was not only a dreamer, he was very well-read and knew the science of his day. In fact, his book is dedicated to the eminent scientist Alexander von Humboldt.

Poe even had an interesting solution for what is known as Olber's paradox: If the universe is infinite and uniformly filled with stars, why isn't the night sky bright rather than dark? Poe reasoned that even if the universe were infinite in size, if the time since it came into existence were finite, there wasn't enough time for the light from very distant stars to have reached us to brighten the night sky.

Conclusion

The nature of reality, the fate of the cosmos, and the ultimate laws of the universe have been pondered for millennia. As insightful and far-sighted as past ages have been, our age clearly stands out as the era of profound discovery. We can say this not only because the vast majority of the discoveries have been made in our epoch, and not only because more than 98% of all the scientists that have ever lived are alive now. It is primarily because we have accumulated a critical mass of knowledge, thanks to the diligent efforts of scientists for hundreds of years. Thanks to these tireless servants of humanity, physics now probes the tiniest of sub-atomic particles and reaches out across the vast expanses of the universe.

Yet physics is a human enterprise fraught with human foibles. The laws of physics have far from perfect agreement with the laws of nature not only because humans are far from perfect, but as pointed out in the Introduction, possibly for reasons intrinsic to any mathematical or logical system. Nevertheless, because physics strives for a close correspondence with nature, the old laws are generally replaced by new laws that retain the old as limited cases. When we think we understand the laws of nature, we can contemplate

mastering the universe. At the least, we can make the world a better place to live in. But it is a two-edged sword since great power for good is also great power for evil.

Physics is about modeling nature and reality. At its simplest level, physics only tries to describe nature. At deeper levels with more complex models, physics tries to predict and explain. Although modeling may be attempted at any given level of reality, it may not be able to go beyond certain levels or domains of validity for intrinsic reasons.

I don't subscribe to the Copenhagen view that reality is only what we can measure. I think reality is accessible to us at a deeper level than this. Some think of reality as direct experience such as experiments. But experiments depend on theory for interpretation. This is what is meant by saying experiments are theory-laden. In the beginning of my paper, I acknowledged that reality may not be the same to everyone. Physics tries in part to answer the question, "What is reality?" Nobel laureate, philosopher-poet Octavio Paz³³ said it beautifully:

"Reality, everything we are, everything that envelops us, that sustains, and simultaneously devours and nourishes us, is richer and more changeable, more alive than all the ideas and systems that attempt to encompass it. . . Thus we do not truly know reality, but only the part of it we are able to reduce to language and concepts. What we call knowledge is knowing enough about a thing to be able to dominate and subdue it."

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Observation and Mass-Spectroscopy Study of Controlled Transmutation of Intermediate Mass Isotopes in Growing Biological Cultures

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Abstract

For the first time the experimental study of cold nuclear transmutation of intermediate mass isotopes was carried out in growing microbiological culture with controlled conditions of growth. With the help of time-of-flight mass-spectroscopy the formation of rare Fe^{54} isotope from Na^{23} and P^{31} isotopes in sugar-salt nutrient medium was observed. Combined and independent Mössbauer and mass-spectroscopy investigations of nuclear transmutation of Mössbauer isotope Fe^{57} in growing biological cultures were also carried out.

Introduction

The problem of nuclear transmutation of elements and isotopes at low interaction energy (at room temperature) in biological objects is discussed. Several years ago^{1, 2} we conducted Mössbauer studies of light (D^2) and intermediate (Mn^{55}) cold isotopes transmutation in several microbiological cultures. We have conducted a series of experiments based upon new technology employing the precise methods of Mössbauer spectroscopy. The experiments were based on the $\text{Mn}^{55} + \text{d}^2 = \text{Fe}^{57}$ reactions in growing microbiological culture in heavy-hydrous (D_2O) sugar-salt nutrient medium deficient in Fe but additionally containing Mn. The reaction result is generation of stable rare Fe^{57} isotope, concentration of which in the natural iron (mainly Fe^{56}) is very low and equals 2.2%. In these experiments the formation of Fe^{57} isotope from Mn^{55} and the light isotope d^2 in nutrient medium based on heavy water was observed by the Mössbauer effect.

Our new report considers the results of both time-of-flight mass-spectroscopy study of nuclear transmutation of intermediate mass isotopes in growing microbiological cultures and combined (Mössbauer and mass-spectroscopy) investigations of nuclear transmutation of isotope Fe^{57} in the same cultures.

We have carried out investigations aimed at discovery and investigation of such nuclear transmutations. We believe that this aim can be achieved only if an isotope obtained in the process of transmutation does not have any analogues in the nutrient medium where the culture is growing (along with inevitably present admixtures of this isotope). As far as we know, none of the previously conducted researches contains reliable data confirming the possibility of cold transmutations for intermediate mass isotopes.

Experimental Method and Procedures

Our experiments on nuclear transmutation of intermediate mass isotopes are based on the expected $\text{Na}^{23} + \text{P}^{31} = \text{Fe}^{54}$ reaction in growing culture in sugar-salt nutrient medium deficient in Fe but containing controlled quantity of Na^{23} and P^{31} isotopes. The reaction results in generation of the rare Fe^{54} isotope, concentration $\eta = 5.8\%$ which in the natural iron (mainly Fe^{56} with natural concentration $\eta = 91.7\%$) is very low. Iron (any isotopes) in small amounts is necessary for the culture growth. If the conditions of nonbarrier cold fusion are satisfied,¹⁻³ the formation of Fe^{54} takes place. We assume that in these cases a short-term elimination of the

Coulomb barrier of the pair nuclear reactions in micro-potential holes with the structure that is close to parabolic¹⁻³ takes place. This condition is realized in the volume of growing microbiological culture. The formed Fe^{54} nuclei during the time $\Delta t \approx 10^{-10} - 10^{-11}$ s are converted to atoms (or ions) and will be utilized by the growing culture for making its structure. The research was carried out on the basis of bacterial culture *Bacillus subtilis*. The Fe^{54} isotope obtained in small quantities can be easily discovered by the means of time-of-flight mass-spectroscopy. This method allows monitoring of the isotope contents of all components of the nutrient medium, the initial culture, and all samples of the culture after its growth has finished.

The course of the experiments was as follows. The previously obtained culture after centrifuging, washing, and post-growth was placed in flasks with sugar-salt nutrient medium containing salts of Mg, Ca, K, Na, sucrose, and 100 ml of pure H_2O water. The composition of the nutrient medium is shown in Table 1.

In accordance with the degree of purification of all nutrient medium ingredients (chemically pure category), the possible content of Fe as an admixture does not exceed $m(\text{Fe}^{54}) \approx 5 \times 10^{-4}$ g or $N(\text{Fe}^{56}) \approx 4 \times 10^{17}$ Fe^{56} atoms. In accordance with the natural content of Fe^{54} isotope (5.8% of the total Fe), its possible quantity as an admixture does not exceed $m(\text{Fe}^{54}) \approx 3 \times 10^{-5}$ g. The total mass and total number of atoms of Na^{23} isotope in NaNO_3 salt are $m(\text{Na}^{23}) \approx 0.13$ g and $N(\text{Na}^{23}) \approx 2.8 \times 10^{21}$. In transmutation experiments, the K_2HPO_4 salt containing less than $\Delta m_{\text{Fe}} \approx 10^{-4}$ g of Fe admixture and $m(\text{P}^{31}) \approx 0.1$ g and $N(\text{P}^{31}) = 1.1 \times 10^{21}$ atoms of basis P^{31} isotope was added to the nutrient medium. All initial dry ingredients of the sugar-salt nutrient medium were investigated on the time-of-flight mass-spectrometer. The same investigation was held with a part of the bacterial culture inoculum.

A typical experiment concerning the nuclear transmutation of elements consisted of growing the microbiological culture in two disks simultaneously (see Figure 1). The first disk contained the fully-compounded hydrous nutrient medium (including NaNO_3) but without K_2HPO_4 ; the second one contained the same hydrous nutrient medium with K_2HPO_4 present. Several series of such control and transmutation experiments were held for different cultures, different times of growth Δt (24, 48, and 72 hours), and different growth modes (in still disks and media and in suspension stirring mode using magnet stirring device).

The cultures were grown in the thermostat at the optimal temperature 32°C . After completing each series, the obtained biological substance was separated using a centrifuge, cleaned in the distilled water, and dried. The total masses of the dried cultures were about 0.3 to 0.7 g.

A typical series of mass-spectrum measurements consisted of three main procedures: a) mass-spectrum investigation of pure natural iron (the basic experiment for obtaining the reference mass-spectrum of all isotopes of iron); b) investigation of the cultures which have been grown in the medium

with presence of Na^{23} (NaNO_3 compound) and without P^{31} ; c) investigation of the cultures which have been grown in full-compounded hydrous nutrient medium with presence of both P^{31} (K_2HPO_4 compound) and Na^{23} (NaNO_3 compound).

The investigated objects were put together in the same vacuum chamber of the laser mass-spectrometer. The cultures were placed on the Pb holder surface in separate microtroughs.

The ruby laser pulses (duration $\tau = 40$ ns, wave-length $\lambda = 0.63$ μm , energy $W = 0.2$ J, size of laser pulse focus $D = 100$ μm , laser plasma temperature $KT \approx 100$ eV) were aimed at each microtrough in turn. The resulting single-charged ions of different isotopes A_i with masses $M_i = A_i M_0$ after energy selection had equal energies $W_0 \approx 40$ eV but different velocities $v_i = (2W/M_i)^{1/2}$ and times-of-flight $t_i = L/v_i$ to the detector. Here $L \approx 100$ cm is the distance of the ion's flight from the laser focus to the detector. Each mass-spectrum was measured during the single laser pulse. The spectra were recorded on the multitrace oscilloscope with memory and later processed on the computer.

Results and Discussion

The mass-spectrum of the isotopes of natural iron (Figure 2a—reference experiment) allows one to carry out exact identification and quantitative interpretation of the summarized spectrum of the impurity (Fe^{56} and Fe^{54}) and synthesized (Fe^{54}) iron isotopes in the researched cultures for the cases b and c (Figure 2b—experiment on transmutation at $\Delta t = 72$ hours, Figure 2c—control experiment). In these experiments the changes of relation of isotope concentrations from natural value $\eta(\text{Fe}^{54})/\eta(\text{Fe}^{56}) \approx 0.06$ (for the case of pure natural Fe and for impurity Fe in the control experiment) to

$\eta(\text{Fe}^{54})/\eta(\text{Fe}^{56}) \approx 0.2 - 0.25$ (for the experiment on transmutation) were observed. For the several more optimal regimes of culture growth we have obtained $\eta(\text{Fe}^{54})/\eta(\text{Fe}^{56}) \approx 0.5 - 0.8$.

The photographs present the mass spectra of the reference, control, and transmutation samples on the multitrace oscilloscope with memory. The upper scan corresponds to the spectrum of natural Fe (reference experiment); the lower scan shows the spectrum of the investigated culture (control or transmutation experiment). It follows from these photos that in the biological cultures mass spectra a small and uniform shift of the traces of all isotopes to the left in relation to the reference spectra of the natural Fe takes place. This shift is a result of the accelerating influence of the heavy Pb ions that are emitted from the supporting surface together with the investigated culture ions during the laser pulse. It follows from these photos that the change of the relation of isotope concentrations from the natural value $\eta(\text{Fe}^{54})/\eta(\text{Fe}^{56}) \approx 0.06$ (for the case of pure natural Fe and for impurity Fe in the control experiment) to $\eta(\text{Fe}^{54})/\eta(\text{Fe}^{56}) \approx 0.2 - 0.25$ (for the experiment on transmutation) takes place.

The recurrence of outcomes was close to 100%.

The averaged experimental coefficients of $\text{Na}^{23} + \text{P}^{31} = \text{Fe}^{54}$ transmutation equal:

$\lambda_p = N(\text{Fe}^{54})/N(\text{P}^{31})\Delta t = [\eta(\text{Fe}^{54})/\eta(\text{Fe}^{56})] N(\text{Fe}^{56})/N(\text{P}^{31})\Delta t \approx (3-6) \times 10^{-10}$ (synthesized Fe^{54} nuclei per s and per single P^{31} nucleus);

$\lambda_{\text{Na}} = N(\text{Fe}^{54})/N(\text{Na}^{23})\Delta t = [\eta(\text{Fe}^{54})/\eta(\text{Fe}^{56})] N(\text{Fe}^{56})/N(\text{Na}^{23})\Delta t \approx (1-2) \times 10^{-10}$ (synthesized Fe^{54} nuclei per s and per single Na^{23} nucleus).

The research of mass-spectra of the dry sugar-salt nutrient

Table 1. The composition of the nutrient medium.

Components of the nutrient medium	Concentration in the medium (%)	Admixture of Fe (no more) relative (%)	Admixture of Fe (no more) absolute (g)
Sucrose	2	10^{-4}	2×10^{-4}
MgSO_4	0.05	2×10^{-4}	10^{-5}
CaCO_3	0.2	1.5×10^{-4}	3×10^{-5}
KCl	0.05	3×10^{-4}	1.5×10^{-5}
NaNO_3	0.5	2×10^{-4}	10^{-4}
K_2HPO_4 (in transmutation experiments)	0.2	5×10^{-4}	10^{-4}
Pure distilled water H_2O	100 (100 ml)	10^{-7}	10^{-5}

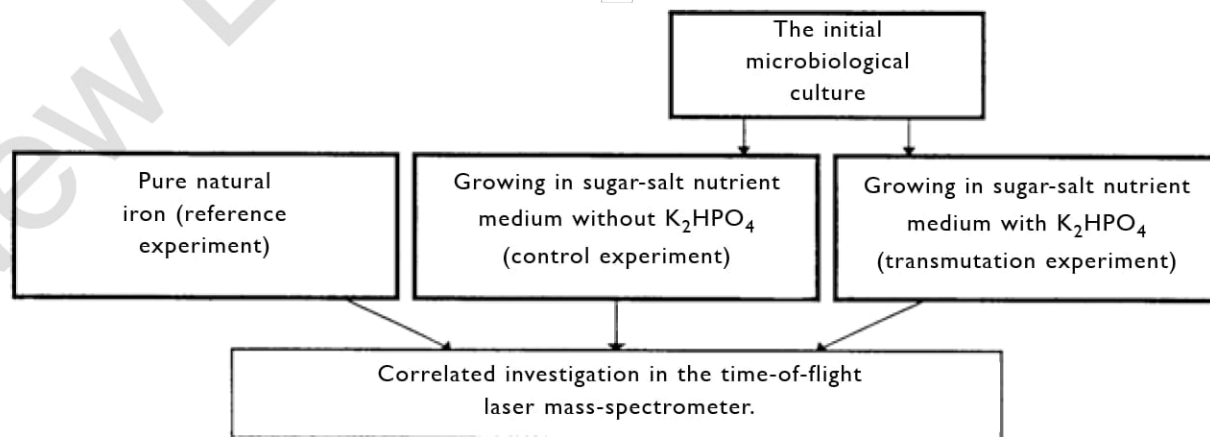


Figure 1. The scheme of experiment on transmutation and mass-spectroscopy investigation of isotopes in growing microbiological cultures.

medium (before and after the action of the same laser pulse) was also carried out. The measurements have shown that the relation of concentrations $\eta(\text{Fe}^{54})/\eta(\text{Fe}^{56})$ both in the separate components of the nutrient medium and in their mixture (especially in the mixture of the main salts NaNO_3 and K_2HPO_4) remains natural and equals about 0.06. This confirms the conclusion that the formation of Fe^{54} isotope and changes of the isotopes relation $\eta(\text{Fe}^{54})/\eta(\text{Fe}^{56})$ observed at the growth of culture in an optimal medium with the presence of Na and P salts is the result of cold nuclear transmutation $\text{P}^{31} + \text{Na}^{23} = \text{Fe}^{54}$ and is not connected to the thermal action of laser impulse on the target in the mass-spectrometer (i.e. the reaction of nuclear transmutation is not a result of the possible "warm fusion" at $KT = 100$ eV in the laser pulse focus).

As a result of the analysis of the main experiment 2b on transmutation and both the reference 2a and the control experiment 2c one can say:

1) In the grown microbiological cultures, the sugar-salt components of the nutrient medium and in the natural iron the relations of Fe^{54} and Fe^{56} isotope concentrations are natural $\eta(\text{Fe}^{54})/\eta(\text{Fe}^{56}) \approx 0.06$;

2) In the sugar-salt components of nutrient medium and in the microbiological cultures grown in the control experiment

we have observed the same natural relation $\eta(\text{Fe}^{54})/\eta(\text{Fe}^{56}) \approx 0.06$ of Fe^{54} and Fe^{56} isotope concentrations;

3) During the culture growth the Fe^{54} isotope isn't extracted from the glass of the disk;

4) The formation of the Fe^{54} isotope and the changes of the isotopes relation $\eta(\text{Fe}^{54})/\eta(\text{Fe}^{56})$ observed during the culture growth in the optimum medium with the presence of Na and P salts is not a result of the possible "warm fusion" $\text{P}^{31} + \text{Na}^{23}$ in the laser focus plasma of the mass-spectrometer.

Summarizing the mentioned results and discussion of the experiments, we can state that the creation of the Fe^{54} isotope as a result of nuclear transmutation in growing biological medium was observed and verified using the time-of-flight mass-spectroscopy method.

What are the possible causes of the observed effect?

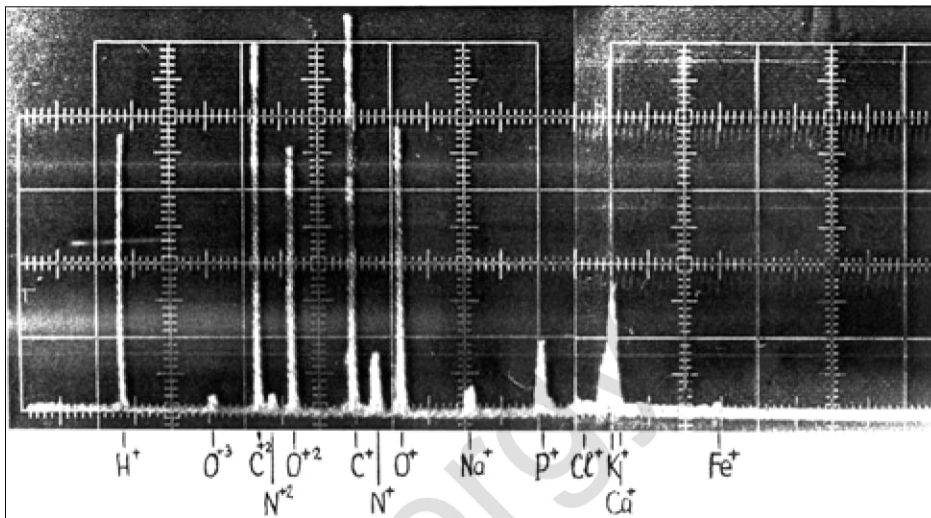
It is evident that usual tunneling quantum processes can't provide a great probability of nuclear transmutation. The Gamow's probability of such reaction

$$P = \exp\{-2\pi Z_{\text{Na}^{23}} Z_{\text{P}^{31}} e^2 [\mu/2KT]^{1/2} / \hbar\}$$

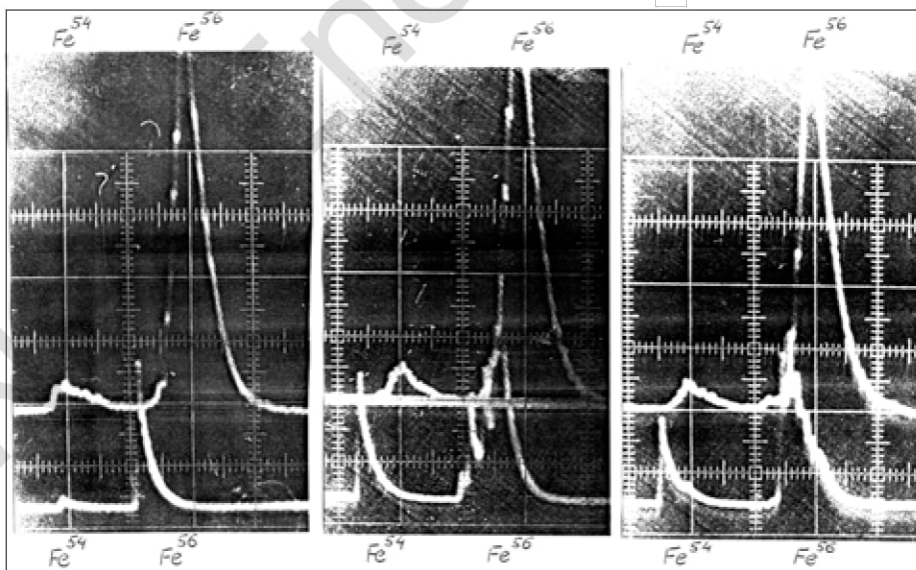
is very small and equals about $P \approx 10^{-1000000}$ for room temperature and $P \approx 10^{-15000}$ at $KT \approx 100$ eV. Here $\mu = M_{\text{Na}^{31}} M_{\text{P}^{31}} / (M_{\text{Na}^{31}} + M_{\text{P}^{31}})$ is the reduced mass of the reaction.

$M_{\text{P}^{31}} / (M_{\text{Na}^{31}} + M_{\text{P}^{31}})$ is the reduced mass of the reaction.

We assume that the most effective process in this case would be the one caused by the mechanism suggested in Reference 3 (and after in Reference 1 and 2), which is capable of providing a short-term interference elimination of the Coulomb barrier of the pair interaction in optimal micro-potential hole with size about $R_0 \approx 6 - 8$ Å and with the structure that is close to parabolic. For such system the diagonal elements of interaction energy matrix of $\text{Na}^{23} + \text{P}^{31}$ complex (quasimolecule NaP) should be small and probability of interlayer transition because of this interaction should also be small. It can be shown that quantizing structures of optimal size and shape are necessary for such non-barrier nuclear interaction. The exact parameters of these structures are very hard to calculate. The situation substantially improves when the hole parameters are slowly changing, inevitably passing through optimal value R_0 . It is possible that this optimal situation is carried out in growing microbiological cultures. In the growth process the replication of DNA and other biomolecules takes place. In this case in the region of growth the inter-atomic potential holes with slowly changing sizes are constantly appearing. If Na and P atoms are in such a changing hole, conditions for a new Fe^{54} isotope fusion could appear. If the condi-



Graph 1: Experiment on transmutation.



Graph 2: Reference experiments (pure Fe) control experiments.

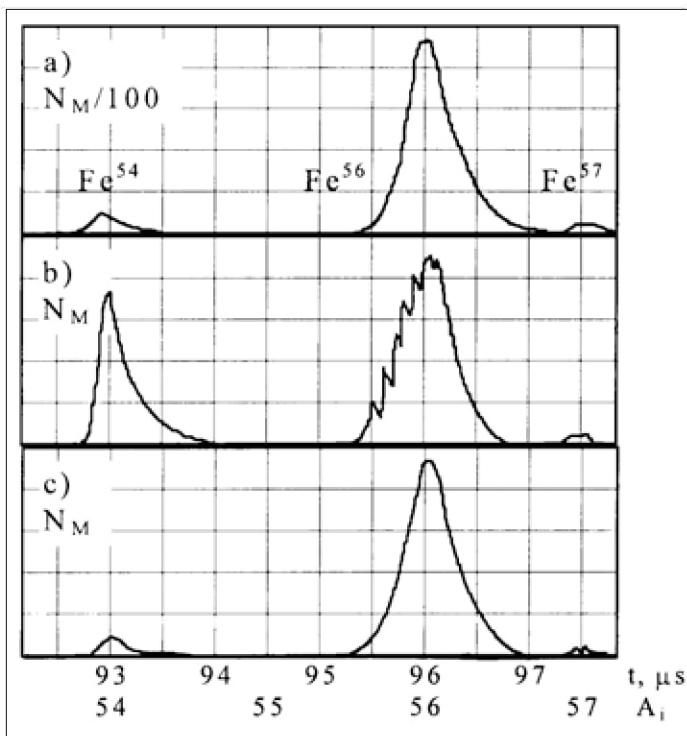


Figure 2. A typical series of mass-spectrometer detection of Fe isotopes: a) reference experiment on pure natural Fe; b) experiment on transmutation (the culture grown in the medium with the presence of P^{31} and Na^{23} isotopes); c) control experiment (the culture grown in the medium without P^{31} isotope); t is the measured time-of-flight of the isotope ion from the target to the detector, A_i is the atomic number of the isotope.

tions of nonbarrier cold fusion are satisfied,³ the formation of Fe^{54} takes place. The formed Fe^{54} nuclei during the time $\Delta t \approx 10^{-10} - 10^{-11}$ s are converted to atoms (or ions) and will be utilized by the growing culture for making its structure.

We believe that the given mechanism completely describes the basic properties of the process of nuclear transmutation, which is observed in experimental course.

Combined Investigations of Nuclear Transmutation of Isotopes in Growing Cultures

The problem of reliability of the experimental results of the low-temperature isotope transmutation process is one of the most important. This aim can be achieved only by using several independent methods of investigation with the same object.

We have carried out investigations aimed at combined but independent Mössbauer and mass-spectroscopy investigation of nuclear transmutation of isotopes in microbiological cultures. These experiments were based on the expected $Mn^{55} + d^2 = Fe^{57}$ reactions in growing microbiological culture in the heavy-hydrous (D_2O) sugar-salt nutrient medium deficient in Fe but additionally containing Mn. The reaction results in generation of the rare stable Fe^{57} isotope, concentration of which in the natural iron (mainly Fe^{56}) is very low ($\approx 2.2\%$).

The course of the transmutation experiments was discussed in our previous investigation.^{1,2}

The research was carried out on the basis of the yeast culture *Saccharomyces cerevisiae*, selected according to the possibility of its growth in light and heavy water media. The previously obtained cultures after centrifuging, washing, and post-growth were placed in a flask with sugar-salt nutrient medium containing the salts of Mg, Ca, K, ammonium tartrate, sucrose, and pure water (D_2O with Mn in transmutation experiments, H_2O with Mn, or D_2O without Mn in control

experiments). In accordance with the degree of purification of all nutrient medium ingredients (chemically pure category), the possible content of Fe^{56} as an admixture did not exceed $m(Fe^{56}) \approx 1.1 \times 10^{-6}$ g and $N(Fe^{56}) \approx 0.9 \times 10^{16}$ atoms. In transmutation experiments, $MnSO_4$ containing $m(Mn^{55}) \approx 2 \times 10^{-4}$ g and $N(Mn^{55}) \approx 1.8 \times 10^{18}$ of Mn^{55} atoms of basis stable Mn^{55} isotope was added to the sugar-salt nutrient medium. The total mass of the culture grown during 72 hours in the optimal medium (D_2O and $MnSO_4$) was near 0.2 to 0.5 g.

Figure 3 presents the results of Mössbauer investigation of this culture. Spectrum 3a presents the Mössbauer spectrum of *Saccharomyces cerevisiae* culture grown during $\Delta t = 72$ hours in the nutrient medium of optimal composition, containing D_2O and $MnSO_4$. The full number of Fe^{57} atoms (calculated by analysis of this Mössbauer spectrum) and their mass are the following: $N(Fe^{57}) \approx 0.87 \times 10^{16}$, $m(Fe^{57}) \approx 10^{-6}$ g.

Spectrum 3b corresponds to the same culture grown in the medium containing H_2O and $MnSO_4$, and Spectrum 3c to the medium with D_2O , but without $MnSO_4$. The coefficient of transmutation (obtained by Mössbauer spectroscopy) equals:

$$\lambda_a(\text{Mössb}) \approx N(Fe^{57})/N(Mn^{55})\Delta t \approx 1.7 \times 10^{-8} \text{ (Fe}^{57} \text{ nuclei per s and per single Mn}^{55} \text{ nucleus).}$$

Figure 4 presents the result of mass-spectrum investigation of this culture. Spectrum 4a (reference experiment) presents the results of mass-spectroscopic investigation of isotopes of the natural iron. Spectrum 4b (additional basic experiment) presents the mass-spectrum of the natural single-isotope Mn chemical element. Spectrum 4c (control experiment) presents the mass-spectrum of the same *Saccharomyces cerevisiae* culture grown in the heavy water nutrient medium with D_2O , but without Mn^{55} isotope (without $MnSO_4$ salt). Spectrum 4d presents the summarized spectrum of the impurity (Fe^{56} and Fe^{54}) and synthesized (Fe^{57}) iron isotopes in the researched culture grown in the heavy water nutrient medium with D_2O and with the Mn^{55} isotope presence.

On the one hand the relation of isotope concentrations in the control experiments (and in the pure natural Fe) equals the natural value $\eta(Fe^{57})/\eta(Fe^{56}) \approx 0.02$.

On the other hand the relation of isotope concentrations in the same culture that was grown during the transmutation experiments and investigated by mass-spectroscopy is much larger: $\eta(Fe^{57})/\eta(Fe^{56}) \approx 0.7 - 0.9$. It follows from these investigations that the total mass and total number of synthesized Fe^{57} isotope nucleus (atoms) equal:

$$m(Fe^{57}) \approx [\eta(Fe^{57})/\eta(Fe^{56})] m(Fe^{56}) \approx (0.8-1) \times 10^{-6} \text{ g and } N(Fe^{57}) \approx (0.6 - 0.8) \times 10^{16}.$$

The coefficient of transmutation (obtained by the method of time-of-flight mass-spectroscopy) equal:

$$\lambda(\text{Mass-spectr}) \approx N(Fe^{57})/N(Mn^{55})\Delta t \approx [\eta(Fe^{57})/\eta(Fe^{56})] N(Fe^{56})/N(Mn^{55})\Delta t \approx (1-1.3) \times 10^{-8} \text{ (Fe}^{57} \text{ nuclei per s and per single Mn}^{55} \text{ nucleus).}$$

It follows from our calculations that the coefficients of light (D^2) and intermediate (Mn^{55}) isotopes cold transmutation investigated by both the Mössbauer spectroscopy and the time-of-flight mass-spectroscopy are approximately equal and exceed by two orders of magnitude the same transmutation coefficient for the case of intermediate (Na^{23} and P^{31}) isotopes transmutation.

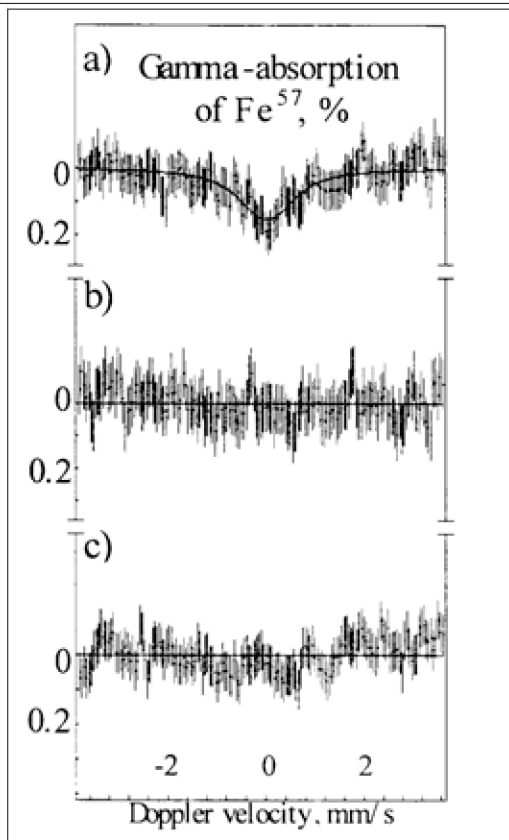


Figure 3. The results of Mössbauer investigation of the culture.

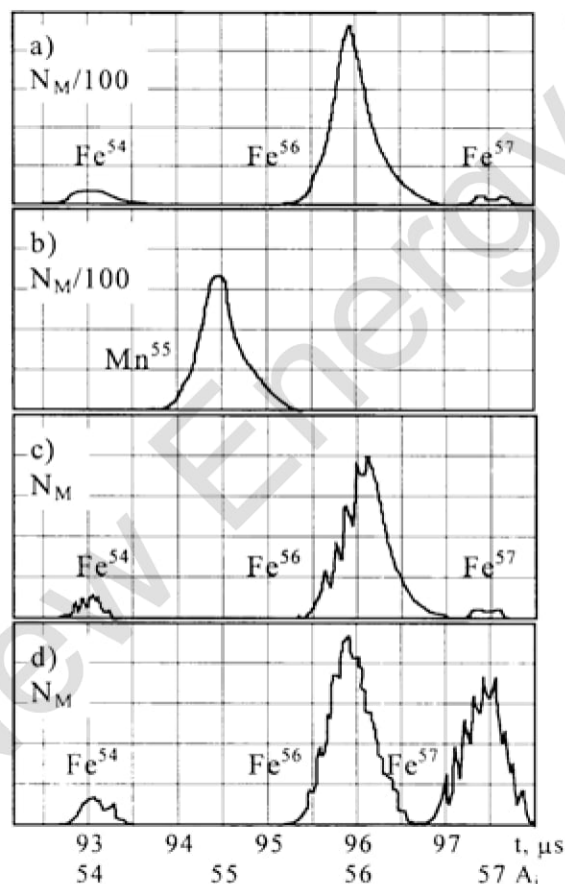


Figure 4. The result of mass-spectrum investigation of the culture.

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3. Vysotskii, V.I. 1993. *Proceedings of the Fourth International Conference on Cold Fusion*, Lahaina, Hawaii, December, 4, pp. 20-21.

1. Dr. Vysotskii received his Bachelor's (1969) and Master's (1974, quantum radiophysics) from Kiev Shevchenko University. He received his Ph.D. in physics in 1975. He was an associate professor in the Radiophysical Faculty at Kiev Shevchenko University from 1979 to 1993. After receiving his Doctor of Science degree in physics in 1992, he became full professor in the Radiophysical Faculty at Kiev Shevchenko University.

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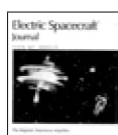
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3. Dr. Samoylenko received his Bachelor's (1962, medicine) from Kuban Medical Institute (Krasnodar). He received his Master's (1966, biochemistry) from Moscow State University. He received his M.D. in biochemistry in 1967. He is head of the laboratory of biophysical and isotopic investigation at Gamaleya Institute of Epidemiology and Microbiology (Moscow).

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4. Dr. Zykov graduated from Radiophysical Faculty at Kiev Shevchenko University in 1955 (physical electronics engineering). He received his Ph.D. in physics in 1975. He is senior scientific researcher and expert in mass-spectroscopy in the Radiophysical Faculty at Kiev Shevchenko University.

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All 30 first and second class children survived. Statistics are from the U.S. Senate and Board of Trade reports.

9. Wade, p. 311.

10. Wade, p. 63.

11. The rumors were described in the U.S. Senate hearings, testimony of survivor Catherine Crosby, and elsewhere. She said, "I have read it in the papers, but I personally know nothing about it." There is no evidence that any of these stories are true.

12. Wade, see footnote 4.

13. Wade, pp. 47-48.

14. For example, Lord, W. 1986. *The Night Lives On*, Morrow; and Baldwin, H.W. 1955. *Sea Fights and Shipwrecks*, Doubleday. Both quote the exchange verbatim. Baldwin writes "... the Senate investigating committee ... brought out numerous pertinent facts, though its proceedings verged at times on the farcical. Senator Smith was ridiculed for his lack of knowledge of the sea when he asked witnesses, 'Of what is an iceberg composed ...'" Baldwin should have wondered how Smith could have "brought out the pertinent facts" if he was such a dunce. Critics assumed Senate staff members or the Navy wrote the report, but Smith wrote it himself.

15. Wade, p. 312.

16. Wade, p. 41. Carlisle also said he never believed "there was such a thing as an unsinkable ship."

17. <http://www.mulderrijke.nl/>

18. Wade, p. 313. Wade comments: "Indeed they were. Among the traditions flouted was the habit of driving full speed into known ice-floe areas. Among the customs was that of sailing with an insufficient number of lifeboats."

19. Wade, p. 279.

20. According to the World Health Organization (WHO), water-borne bacteria causes 4 billion cases of diarrhea per year, resulting in 2.2 million deaths, or 4.3 Titanic disasters every day. Most of the victims are children under age five. Extremely cheap energy used to pump, filter, or boil water would prevent most of these deaths. WHO estimates one-third would be saved with conventional sanitation measures, but I doubt they have made projections based on ultra-low cost energy. The toll comes to 26 million in 12 years. Source: http://www.who.int/water_sanitation_health/Globassessment/Global1.htm#1.1 It is difficult to estimate total deaths in shipwrecks. Ships have been in existence for roughly 5,000 years. Taking into account the low human population in ancient times, and restricted navigation before 1500, I estimate 5 million deaths before 1500 (1,000 per year), and another 5 million since then (10,000 per year). There is some evidence that seafaring began much earlier, perhaps hundreds of thousand of years ago, so perhaps I should say "shipwrecks in recorded history."

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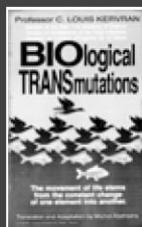
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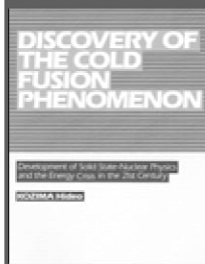
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NSF physics division sent an e-mail message to many NSF colleagues: 'It seems unfortunate that an NSF office [the engineering division] is now appearing to encourage such discredited work. . . .' By contrast, co-chairman Norman Ramsey of Harvard dearly wanted to see the results of the EPRI-NSF meeting. Paul Chu would have obliged, but he said it would be a few months before the report was due to come out. (Unfortunately, the EPRI-NSF report has still not been published.) In guiding the Panel to its conclusions, Huizenga had shown the members purported evidence that Fleischmann and Pons had broken their agreements with BYU. (Question: What did that have to do with science?) One panel member, H. Guyford Stever, characterized Fleischmann and Pons's behavior as 'bad science.' Within a year, Stever would be appointed the head of a federal panel charged with plotting the future course of hot fusion. . .

"The negative ERAB report undoubtedly provided a convenient justification within the DOE bureaucracy for reducing federal funding for cold fusion research. Two million dollars were summarily removed from fiscal year 1990 funding of the Division of Advanced Energy Projects led by Dr. Gajewski. This, in effect, put a damper on cold fusion research, but did it in a way that was not directly traceable to the report. At the EPRI-NSF meeting, Gajewski had made it known that he would support cold fusion projects. But now the 'modest support for carefully focused and cooperative experiments within the present funding system' favored by the ERAB report went up in a cloud of bureaucratic smoke fueled by the negativists. . .

"Though the DOE panel had let cold fusion down, positive results from the DOE's own laboratories, Oak Ridge and Los Alamos, were beginning to surface. Los Alamos was strong on anomalous tritium and neutrons. ORNL had gotten tritium bursts, excess heat, and low level neutrons. Yet without winking, Huizenga claimed that the DOE panel had considered ORNL and LANL findings. How so? Pons, for one, reacted angrily to the DOE report in the *Desert News*: 'They have made their judgment; they have passed sentence on fusion and they've been proven wrong. They were wrong from day one. The DOE appointed a bunch of negative people to give a negative decision. They will continue to be proven wrong—even by their own laboratories.'"

Now that I see the level of detail on the above-mentioned positive findings that were reported by ORNL and LANL in the EPRI-NSF meeting, Pons' words ring ever more true. This entire affair at DOE was a pre-ordained rush-to-judgment by a bunch of closed-minded bureaucratic scientists. None of them have had the integrity or decency in the intervening years to change their inept, wrong, and now it can be seen so very clearly—*immoral*—conclusions.

References:

1. Mallove, E. 1991. *Fire from Ice: Searching for the Truth Behind the Cold Fusion Furor*, John Wiley & Sons.
2. SRI International and EPRI. 1994. "Development of Advanced Concepts for Nuclear Processes in Deuterated Metals," McKubre, M.C.H. et al., EPRI TR-104195, Research Project 3170-01, Final Report, August 1994, 128 pages, plus 342 pages on microfiche.
3. Mallove, E. 1999. "MIT and Cold Fusion: A Special Report," *Infinite Energy*, 4, 24, 66-119.
4. Mallove, E. *Fire from Ice*, p. 182.
5. Mallove, E. 2000. "The Triumph of Alchemy: John Bockris and The Transmutation Crisis at Texas A&M," *Infinite Energy*, 5, 32, 9-24.

This is big news. It means that nuclear power plants in this country are safer than even their most ardent proponents have claimed. This is disappointing to anti-nuclear activists because it shows that they have been wrong all along. It appears to have disappointed the editors of the *New York Times* as well.

They did not rush to correct the "untold-thousands-of-deaths" false claim. Ten days after getting AIM's letter, they published a four-sentence faux-correction in the correction box alongside corrections of a misspelled name and a wrong date. It said that the story had given an incorrect description of the number of deaths and illnesses caused by the Chernobyl accident, but instead of giving the correct numbers, it said, "It has not been established that the accident caused untold thousands of deaths and illnesses." That gives the impression that it may be true.

It noted that an "official report" said that thirty-one people had died in the first weeks after the accident. Identifying the report would have added to its credibility. Nor did they want to disclose that the report said that only forty-eight had died in the first ten years and that there was no evidence of an increase in any cancers except treatable thyroid cancer. It said, "Other estimates of deaths ultimately caused by the accident range from dozens to tens of thousands." This suggests that the editors believe that wild guesses by anti-nuclear activists are just as valid as peer-reviewed scientific studies.

This is what happens when those who make the mistakes are assigned to correct them.

Eclectic Observer continued from page 43

VooDoo Playboy

Infinite Energy magazine is mentioned in the January 2001 issue of *Playboy* magazine, part of an article by Dr. Robert Park of the American Physical Society. We are not regular readers of *Playboy*, but we were alerted to this article's appearance by Sir Arthur C. Clarke, who has a fine opinion piece, "2001, Hello," in the same issue. Park mentions *Infinite Energy* in a supposedly negative context. In part:

"What emerged after all the media hype was not a story of a dazzling scientific breakthrough, but a sad comedy about wishful interpretations of sloppy and incomplete experiments, evolved into altered data and suppression of contradictory evidence. By July 1989, when a Department of Energy panel concluded that additional research into cold fusion was not warranted, most scientists had already returned to more productive lines of research. . . . Not taken seriously by other scientists, the cold-fusion faithful hold their own meetings and have their own magazine with the all-too-predictable title *Infinite Energy*. . ."

The article continues with the story about Dr. Paul LaViolette's firing from the U.S. patent office and his defense before the Equal Opportunity Employment Commission. Other parts of the Park article attack BlackLight Power Corporation and Dr. Randell Mills, Presidential candidate John Hagelin, plus various other good and not so good science. This is all mixed together in a pastiche of confusion and scientific bigotry, for which Park has become justly famous.

Let us hope for and work toward better news in 2001 than this obscenity from science playboy and dilettante Park.





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